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SECRETARY'S NOTES.

THE Council having decided to allot monthly a space in the JOURNAL to enable the Secretary to keep the Members acquainted with matters of interest concerning the Institution, the following items are detailed for their information :—

1. Two Special Committees of the Council are now sitting, one naval and one military, to consider in what way or ways the Institution can become of greater usefulness to the Officers of the Navy and Army.

2. A catalogue of the contents of the Museum is now being compiled, and considerable progress has already been made. Up to the present nearly a thousand exhibits have been numbered and described, and it is hoped that by the end of next year the work will have been completed. The catalogue will be printed for sale.

3. Mr. Thomas McKnight, the Assistant Curator, who has been in the service of the Institution for over 26 years, and who retires at the end of the current year, has been awarded by the Council a pension of £30 per annum for his long and faithful service. Mr. McKnight is 66 years of age, and was formerly Mess Sergeant at the R.A. Mess, Woolwich. He is well known to many Members of the Institution.

4. The Council have recently lost the services of a very useful servant in the death of the Senior Attendant, James J. Pike, late Petty Officer, 1st Class, R.N. Mr. Pike had been in the service of the Institution for over 18 years, and had been in charge of the Naval Exhibits in the Banqueting Hall for 10 years. He recently re-rigged the large model of the ship of the Hanseatic League of 1665, and it is now considered to be one of the finest models of the date in existence, the only one to equal it being preserved in the Musée de Marine at Paris. The Council decided early in the present year to fit a suit of sails to the large model of H.M.S. "Cornwallis," built 1812. Mr. Pike worked at the model until his death, when it was completed by the next Senior Naval Attendant, John Smith, late Petty Officer, 1st Class R.N. The model is a large one, and was built at Bombay simultaneously with the ship which it represents. It was presented to the Museum by the Directors of the late Honourable East India Company.

5. The following exhibits have recently been added to the Museum :—

(1) A set of surgical instruments used on board H.M.S. "Temeraire" at the Battle of Trafalgar, given by Mrs. Caird, of East Croydon.

(2) The orders and an original portrait of the late Lieut.-General Sir Hudson Lowe, bequeathed by Miss C. M. Lowe.

(3) A photograph of J. Roon, one of the signal-men of H.M.S. "Victory," who hoisted Lord Nelson's last signal at Trafalgar. Taken at Greenwich Hospital in 1858, and presented by Dr. J. Davis, R.N., F.R.C.S., Inspector-General of Hospitals and Fleets (Retired).

6. The old Colours of French Regiments, taken during the wars of 1793-1815, have been carefully repaired, and will now doubtless last for many years to come.

7. A special case has been devoted in the Museum to Wellington Relics and it is hoped that those in possession of objects of military interest in connection with the Duke will kindly contribute to the case. Should this prove a success, it is hoped to start a collection of the Duke of Marlborough's Relics.

8. A Catalogue of the Parliamentary Papers in the Library, numbering between twelve and thirteen hundred, has recently been compiled.

9. The Council have decided to close the Institution at 7 p.m. instead of at 8 p.m. during the winter, from December 1st, 1904.

MECHANICALLY PROPELLED VEHICLES FOR MILITARY PURPOSES.

By Brevet Major C. E. I. McNALTY, Army Service Corps.

Wednesday, 6th July, 1904.

The Right Hon. GRAHAM MURRAY, M.P., Secretary for Scotland, in the Chair.

BEFORE reading my paper, it may be said that the question of the use of mechanically propelled vehicles is one of to-day, and not one of the past; it is, therefore, with a view of ventilating the difficulties to be overcome, rather than their solution, that this paper is written. In the discussion of a subject in a state of rapid evolution, it is not easy to differentiate between the present, past, and future. We are liable to allow our minds to become prejudiced by the failures of the past without carefully examining into the cause, or to become enthusiastic with the dreams of the future without enquiring into their practicability, whilst the ever-changing present does away to-day with the defect of the day before, or raises some fresh problem to be solved.

The same principles govern transport and locomotion, whether civil or military, by land or sea, in each consecutive age.

In 1798 the military reinforcements and stores sent to Ireland had to travel along by roads and in wagons, taking many days to reach their destination. Nowadays we move troops, etc., by rail to Ireland, and the journey can be completed in one day.

To continue the analogy, up to recently, civilians, their luggage, and stores went by railway. Now we have come to another development, and the most modern science has brought us back to roads, roads which have always been a commanding factor in strategy. People now travel to a great extent by road, taking their luggage with them, and stores are also transported in this manner, so that it would not be in advance of the times to convey troops and military stores in a like manner.

The title of the subject for discussion to-day is somewhat comprehensive. To arrive at useful conclusions it is necessary to consider it under the following headings:—

1. Motor cars for the conveyance of general and staff officers, and for the transport of men for fighting and technical services.
2. Motor cyclists as messengers and for combatant purposes.
3. Mechanically propelled vehicles for transport of munitions of war, and haulage of the heavy field guns.

Of these headings, No. 3 has received the greatest attention up to the present, has been seriously adopted, and steps are being taken to render it as efficient as possible. The other sub-divisions of the subject, with the exception of motor cars for general and staff officers, have not yet had their utility tested. I therefore propose to mainly devote my paper to dealing with the employment of mechanical transport for the haulage of guns and stores, with a view to demonstrating how much more can be done by practically testing the possibilities and limitations of the machines in question by actually using them, instead of theorising about them on paper. We are all aware of the lengthy discussions that preceded the purchase of submarines for the Navy, and now they have advanced beyond the experimental stage by a few being actually put to use.

Motor Cars.

Passing to the first sub-head mentioned, we will now briefly consider the military use of the motor cars.

Although motor cars as at present used and constructed for military purposes cannot claim any financial saving, as the expense of upkeep is considerably more than the amount saved in travelling expenses, the car is a most valuable and almost indispensable adjunct to the means already at the disposal of a general officer and his staff at the present time for supervising the proper training of the troops in his command. In war time, of course, the question of expense must fall to the ground before that of efficiency.

Too much stress cannot be laid on the importance of general officers having the means to personally, at any moment, inspect and supervise the working of their commands instead of relying upon a prearranged periodical visit; it is only with the aid of motor cars that this can be done. Personal supervision is of more value than all the volumes of orders, regulations, and carefully prepared reports put together can ever be.

Troops at stations are now more scattered and field operations more extended, thus necessitating the supervision of the staff over a much larger area. With the ordinary means of transport, either proper and efficient personal supervision cannot be given at all, or, if given, is only possible at great expense of time, causing other important work to be left undone, and very often at considerable personal expense to the officers of the staff, and the premature exhaustion of their energies.

The cars which have been used experimentally by the Mechanical Transport Committee have been found of great value, but they have been in some cases considerably over-worked, insufficient time having been allowed for their proper and economical upkeep. The result of this overwork has been extensive, and costly repairs, that would probably have been avoided had small defects been rectified at once, have become necessary.

The peace establishment of motor cars is about three per army corps, but general, staff, and other officers have found their use to so considerably facilitate their work, that a number of private cars are being used for the execution of the public service, maintained at the personal expense of the officer concerned.

I will not speculate as to what might have happened had generals in wars of the past been able rapidly to proceed by motor cars to the various scenes of action of their armies; but it may be observed that more than one general in our own Army have earned their reputation and secured the success of our arms by their ubiquity, marvellous considering the means at their disposal.

Napoleon, in conducting his wars and campaigns, made many long journeys at considerable physical self-sacrifice in order to be present in the proper place at the psychological moment. How much greater might have been his successes had he had motor cars at his disposal for conveyance!

Motor cars, even as they are at present constructed, are capable of passing over country that animals would negotiate more slowly, with continual and irritating stoppages. (Note: Fentiman across the Alps in a 16-H.P. Peugeot, the recent ascent of Snowden, etc.) Though it is admitted there are many places at present that animals can traverse, impossible for machines, in the future we look for the movement of motor cars over all surfaces possible to the animal.

In addition to the motor cars used for staff work and a few for technical duties, the only organised body of motorists is the Motor Volunteer Corps. The present strength of the Motor Volunteers is 29 officers possessing motor cars and 1 officer with a motor cycle. The members of this corps have 76 cars and 40 motor cycles. At last year's manœuvres the motor cars were used for conveying staff officers, and the cyclists were used as messengers. It is somewhat disappointing that they were not used for combatant purposes; it is contemplated to use them in the latter capacity during manœuvres this year. The Motor Volunteers place their machines at the public service, and receive 30s. a day while employed. It is unnecessary to say the cost to the Government would have been doubled, if not trebled, if these cars had been hired from an ordinary commercial firm. In addition to military work some of the cars were used by the compensation staff, whose duty it was to inspect and adjudge the value of the damage done by the troops. By using motor cars they were able to immediately visit places where the troops had been, and settle forthwith with the owners of property which had been damaged. The effect of this immediate settlement was most satisfactory to both parties, and resulted in a very considerable reduction in the amount spent on compensation in previous years.

As I have already said, generals in every age have utilised the most rapid means at the time available for the transport of their men. Napoleon marched his infantry by carrying numbers of them in wagons and country carts on many occasions, notably in his march from Boulogne to the Rhine in 1805. This march was one of the most rapid of his age, enabling him to surprise Mack at Ulm on the Danube, where he compelled him to capitulate. Jackson, in his quick march through Virginia, to facilitate his movement put some of his men in railway wagons, and some marched along the road by the side of the railway, taking their turn in the train with the others when fatigued. Many instances may be quoted.

Railways have played a most important part in all recent wars, but as the trains cannot leave the permanent way they considerably hamper the general in his movements. With motor cars, properly constructed for carrying guns and men, it would do away with the

great encumbrance of being tied to railways, of which there must be relatively few compared to roads.

We are constantly told in text-books and by other authorities that owing to the great power of modern weapons, cavalry or mounted infantry can hold positions for a period and act as tactical detaining forces, impossible with the earlier instruments of war, as well as cover flanks and assail flanks in battle; but mounted infantry could not do half so well as men conveyed in motor cars—shall we call them motor infantry?—who could turn up with triple the celerity in the most unlikely places, and surprise and harass the enemy in most theatres of modern war. Moreover, timely reinforcements can save battles, protect retreats, or enfilade flanks; thus a brigade at the first battle of Bull's Run in 1861, coming out of a train, gave the victory to the Confederate general, Beauregard, and a few guns against the Federal right at the second battle of Bull's Run in 1862 facilitated Jackson's defence.

But the virtue of the motor does not rest in rapidly covering short distances. It is in its capacity to travel for long continuous periods and for great distances without having to stop for rest that its great military value lies.

For a force acting on the defensive in its own country, where every road is well known and free from obstruction, motor cars are invaluable. As the pace at which one proceeds increases, so, in proportion, does the difficulty in finding one's way become the more either by day or night, and one can quite imagine the sensations of a driver of a motor car belonging to an invading Army, who is not only unfamiliar with the roads, but who is also unaware of what obstacles may have been placed in his path.

I have mentioned that there is at present no financial saving in the use of motor cars as at present used, but their employment in lieu of cavalry to act as scouts or as a screen, would, I think, be far less costly, because the number required would be far less. As an example may be quoted the great screen of 20,000 German cavalry that covered the 3rd and 4th German Armies from Stenay, by Vitry and Vassy in August, 1870. This enormous cloud of horsemen only covered a frontage of about 60 miles, and then failed to locate MacMahon at Chalons, and it was not until he had received orders to relieve Metz that he was encountered by the Germans on their extreme right, when moving on that place, and the well-known battle of Sedan ensued. The work done on that occasion by the German cavalry would have been far more effectively carried out by motor infantry, and at a very much lower cost.

In speaking of defensive operations guerilla warfare cannot be neglected, and this method of warfare will be facilitated in every direction and phase by motor infantry. In an emergency time does not permit of men being trained to ride horses—as an example of this at the very beginning of the 1870 war it was necessary to spend time to train the Engineers to ride on horseback in order to enable them to proceed rapidly to blow up a bridge, Zweibrucken Viaduct—but they can always be placed in cars and proceed rapidly from one place to another. Raids against the invaders' communication could be carried on with surpassing facility, and there would be few difficulties as to repairs, mechanical aid, motive power, and similar details, because the motor industry is now, or will soon be, part of the daily life of a large number of shopkeepers and operatives in every large town.

What has been said with reference to the conveyance of men by motor cars equally applies to that of machine and light guns, and a motor carriage at the present moment is being constructed in America to carry two 6-pounders, and I believe an enterprising member of the Motor Volunteer Corps is willing to have a car constructed for the conveyance of a Maxim, should one be allotted to his corps.

For a Volunteer arm of the Service for the internal defence of the United Kingdom, I cannot imagine any more effective than one composed of motor infantry. Infantry thus conveyed can assemble immediately at any point, without having to wait to arrange for trains, with all the irritating delays which are likely to occur on such occasions. Of course, the railways would be placed at the disposal of the Government should an invasion threaten this country, but we must remember the sudden upheaval of the ordinary traffic arrangement will not conduce to expedite the working of the railway.

The invader is, moreover, as fully aware as ourselves as to where the bulk of our forces are situated, where they would mobilise in case of war, and also would possess a map of our railway system; he would naturally avoid attempting a landing where our forces could be rapidly concentrated by rail.

In dealing with the conditions a military motor car should fulfil, the following are the principal points to be considered:—

a. It should be driven by an internal combustion engine capable of using a less volatile oil than petroleum spirit.

b. All military motor cars should be of a standard type.

c. Should be as silent and raising as little dust as possible.

d. Tyres to be inexpensive and reliable.

e. Reliability and capacity for hill climbing and for passing over difficult ground to be of first importance compared with high speed.

f. Handy to control, and of as few wearing parts as possible.

g. Easy of repair in the field.

Conditions *a* are open to discussion. There are many advocates of the steam car, but it is unnecessary for me to give an opinion in the face of the fact of the comparative number of manufacturers of steam and internal combustion cars and the comparative numbers on the road. Of course, the small radius of action of the electric car and many other reasons place it at present outside the pale of military consideration. With reference to the nature of oils to be used, there are three principal reasons why petroleum spirit is unsuitable, the first being that it is exceedingly volatile, thus rendering its handling, carriage, and storage one of difficulty, especially so in high temperatures, and in war time these difficulties would be only increased. We are all aware of the stringent regulations that exist with reference to its use in this country. The question that naturally arises is, is it easier to provide for the safe carriage, etc., of petroleum spirit or to construct engines using less volatile oil? It will be particularly interesting to hear opinions on this point. I am inclined to the opinion that the latter will be the best solution, and engines of this nature are being made. The second reason is that petroleum spirit is difficult to obtain in many places, and, thirdly, that it is more expensive than paraffin and other hydro-carbon oils.

Reference to the use of motor cars of technical services, I may mention that motor cars fitted with search-light apparatus are being used by the Royal Engineers. They were originally intended for the late South African War, but were not completed till after that campaign. They were used successfully, I believe, in last year's manœuvres. There are many other duties for which motor cars could be used, but it is for the officers carrying out those services to say to what degree they are likely to be of use.

Motor Cycles.

We now come to the consideration of motor cycles. What has been said of the tactical advantage of motor cars may be said of motor cycles, but they differ in many ways. To the ordinary observer a motor cycle seems to be a somewhat complicated and unmanageable machine, but, as a matter of fact, it is a very simple one, and taking an individual who is equally ignorant of a horse and motor cycle, I am quite sure he would learn to ride and manage the latter in far less time than he would the former. The motor cycle can go wherever the car can go. In addition it can go through narrow lanes, along footpaths, through narrow gates, and can be lifted over obstacles such as stiles, etc., and it would require no great measure of ingenuity to have appliances fitted so that one cycle could assist another or be united in such a manner so as to carry a machine gun. The cycle does not raise so much dust, and can be quickly concealed. The fact of its simplicity renders its repair and supply of spare parts very easy. It burns less petrol than a car, and, of course, if the engine fails it can be pedalled. The cost of upkeep of tyres for a motor cycle is less than that of a motor car. The machine can be so constructed so that the engine can be easily removed, in order that in case of emergency where it might be desirable to use the bicycle as an ordinary pedalled machine, this could be done. But, as compared with the car, it has against it a tendency to side-slip, is noisy, and is a bad hill climber, and very difficult to start up a slope.

The horse, of course, has the advantage of being able to negotiate almost any country, but, as I have already said, the motor cycle can go in many places besides roads, and it has the following advantages:—Great rapidity, enormous radius of action, smaller cost for purchase and maintenance, requires little food, if I may so express it, and only then when working.

The fact that one can dismount and leave the cycle unattended is greatly in the favour of the cycle, when one remembers that 20 per cent. of mounted infantry are supposed to remain out of action in care of the horses. Further, in addition to being able to perform long continuous journeys, the rider arrives at his destination in a fitter state to perform whatever work he has to do than he would if he had been riding a horse.

Trimobiles, quadricycles, and such machines may be classed under the head of motor cycles, and whatever has already been said of the latter practically applies to the former.

With the exception of those in possession of the Motor Volunteer Corps, there are no motor cycles in the Army, though a number of privately-owned machines are constantly being used for military duties. During last year's manœuvres those belonging to the Motor Volunteers were placed at the disposal of the Umpire Staff. The weather and

roads were far from being good. At the beginning of the manœuvres it poured with rain. The roads were chalky and became very slippery. On the whole, the manœuvres demonstrated that an orderly mounted on a horse was preferable for short distances over difficult country, but for long distances, even if the cyclist had to dismount from his machine and walk for some little distance to reach the officer to whom the message was sent, the motor cycle remains unequalled.

It must be understood that the remarks I have made about the use of motor cars and cycles do not pretend by any means to completely deal with the subject, but only to open a field of discussion.

The Use of Mechanically Propelled Vehicles for the Transport of Stores and the Haulage of Heavy Field Guns.

The question of transport of material of every description by mechanical means where animals are now used is one which for some years past has been the subject of much enquiry and experiment. The returns of large commercial companies, who were the first to adopt this means of transport as a practical undertaking, show that it is less costly than animal haulage, and this has entirely been borne out in its employment in the Army. Its employment in South Africa resulted in a saving of at least £50,000 over animal haulage, and this in spite of the very adverse circumstances under which it was employed. But the financial advantage accruing from the use of mechanical transport is liable to be entirely lost, if means are not provided for the efficient and immediate carrying out of repairs and the proper training of the *personnel*.

The advantages of mechanical transport of stores from a military point of view are many; the following are perhaps the most important:—

1. Greater loads and the absence of long teams of animals reduce the length of a convoy to a minimum, and consequently diminish the strength of the escort required.
2. If likely to be captured by the enemy, it takes but few minutes to render the engine useless; nor can the loaded trucks be removed without an engine.
3. It is absolutely free from the ravages of the diseases common to transport animals; it does not foul camping grounds, or strew the theatre of war with rotting carcases.
4. The *personnel* required is very much smaller than that required for animal transport.
5. The bulk and cost of fuel is less than that of the food for animals, except those that exist by grazing, which, on the other hand, must do so at regular and often particular times of the day.
6. It is easier to move by rail or sea.
7. When the engines are fitted with a crane it can form its own loading party to a great extent.
8. Climatic influences do not affect its working, so long as the ground is suitable for its action.
9. Long and continuous journeys can be performed without fatigue.

Summed up, then, mechanical transport can be used with great advantage wherever the surface of the ground is suitable, thus setting free the animal transport for use in districts where it alone can work, and easing the railway of the carriage of stores, so as to allow of a passage of troops and guns.

The Royal Engineers have used traction engines, etc., to some extent for many years, but it was not until the spring of last year that mechanical transport was officially included in the organisation of the transport branch of the Army, *i.e.*, the Army Service Corps. Engines are also being used by the Artillery for their movable armaments, and it is proposed to use them still further, and provide a permanent establishment for the movement of heavy field guns.

The forms of machines at present and hitherto in use in the Army are of mainly two types, viz.: traction engines and lorries, both of which are more or less the commercial pattern. The traction engines at present in use by the mechanical transport vary in weight from 10 to 19 tons, and only differ from the commercial type in that they have been specially strengthened, the tyres of their wheels broadened, etc., to meet the rough work they have to perform in the Army. The engines are well designed and strongly constructed, keep steam easily, and are accessible as to their parts. Engines of this type performed yeoman service in South Africa when used in their proper sphere, and effected a saving of some £50,000. Their great H.P. and weight make them capable of hauling 25 tons of useful load, or a gross load of 45 tons on average roads. They have a winding drum and wire hawser by which they can wind themselves over difficult ground or up steep gradients, and then, having anchored themselves, proceed to wind their train truck by truck, or as a whole, after them. So long as they can get a bearing without sinking too deep they can work their way over most surfaces. The ability of these engines to haul heavy loads makes them exceedingly economical, in addition to which they are economical in their consumption of fuel and water. Oil, coal, or wood can be used as fuel, and in a country where wood is plentiful they resemble the animal that subsists by grazing, since they can collect their fuel as they proceed. Traction engines of a similar design but of lighter type, weighing from 8 to 10 tons, were used in South Africa, and the evidence of the officers under whom they were working shows that they worked more successfully over soft ground than the heavier type. The advantage of engines of being able to leave their trucks to be loaded or unloaded and to pass their train piecemeal over weak and temporary bridges, and of being used for other purposes, such as pumping, driving machinery, or lighting purposes, is obvious.

The other type of mechanically propelled vehicle at present in use in the Army for the carriage of stores is known as the lorry, and differs from the traction engine in that it carries its load on the same structure as the engine. This latter type of vehicle has been used principally for station work, where the roads are fairly good, and on the whole have given good results. The majority of those in use are fitted with smooth tyres, and this alone makes them quite unsuitable for work on such surfaces as soft camping ground, etc. As general service vehicles they are not suitable. The great disadvantage from which the lorries suffer is that of not being able to extricate themselves when in difficulties on bad ground, even when fitted with a wire hawser and winding drum. The useless moving weight and road pressure per

wheel is greater than that necessary with a traction engine. The firm of Messrs. Thornycroft & Co. have gone to considerable trouble and expense to make the lorry suitable for general service work in the Army, but for the reasons already stated the sphere of work is limited. In their favour it is to be noted that they are very handy machines, can quickly get up steam, move rapidly, have a smart appearance, and can be driven by one man.

Haulage of Heavy Field Guns and Armament.

The haulage of heavy field guns by mechanical means has been under consideration for some time, and I think what has been said about the conveyance of stores applies equally to the transport of guns, with this exception: that heavy field guns may have to occupy positions very difficult to reach, but such difficult ground would only be for comparatively short distances. It has been suggested that the engines should draw the guns as far as possible, accompanied by a team of horses to drag them over any bad ground. It will be said: what is the use of having two means of transport? But this, on second thought, answers itself. The horses will only be required to bring the guns into action in a position the approach to which is impossible to an engine. The engines are intended to relieve the horses of their most fatiguing, most wearing work, that of long continuous hours in the collar, and often without proper intervals for watering and feeding, leading to lameness, want of strength and weight, and eventually to the cruelty of death from overwork, and the using up of team after team of horses during a campaign. Every war that has taken place affords ample evidence of the enormous sacrifice of animals, and the overburdened taxpayer has a more acute realisation of the cruelty than ever he had in times of peace.

Traction engines were used extensively in the recent rearmament of Gibraltar. The guns, weighing 30 tons, with the "drug" being taken up 500 feet, the gradient being about 1 in 6 in some parts. The higher portion of the road being zig-zag and narrow, the guns had to be winched up—a very slow and laborious operation compared with the first part of the journey. I may say that for no part of the journey could animal haulage be used. Similar services were rendered in mounting the heavy guns in the forts around Pretoria during the South African war.

Artillerists suggest that the best equipment for a battery of 4·7-inch or 5-inch guns would appear to be as follows:—

For each sub-division of one gun, two engines, of which one to draw one wagon and the gun, and the other to draw two wagons.

The loads of these wagons to be as follows:—

	Tons.	Cwt.
Wagon with gun	5	0
Water and fuel	1	13
12 men	0	18
10 rounds ammunition	0	8
Stores	0	6
Total	8	5

1st Wagon of 2nd Engine	Tons.	Cwt.
Water and fuel	1	13
4 men	0	6
25 rounds ammunition	1	0
Stores	0	6
Total	3	5

2nd Wagon of 2nd Engine	Tons.	Cwt.
65 rounds ammunition	2	12
Stores, kits, etc.	0	15
Total	3	7

It is unnecessary for me to say any more on this point in view of the presence of artillery officers, who, I hope, will give us the benefit of their opinions.

Problems now being Solved With a View to Increasing the Efficiency of Mechanical Transport.

With a view to increasing the efficiency of mechanically propelled vehicles for military purposes, the three great problems to be solved are:—

1. A more extended radius of action than hitherto has been possible.
2. The possibility of negotiating greasy, soft, or broken ground, and steep gradients.
3. Absence of noise and smoke.

These are the problems which the Mechanical Transport Committee are working at, and, though very shortly stated here, are problems the solution of which will only be found after very careful investigations and by an intimate knowledge of the science of self-propelled vehicles and the problems of military transport.

The requirements of an efficient military vehicle of this nature differ from those in commercial life. Thus it is necessary that the trade should be led in this matter, and the more efficient machines that have been evolved is due to this leading and the hearty co-operation of the manufacturers, who have in some instances expended money as well as thought and time on the matter. Before entering on a description of the work that has been done (since the South African War) with a view to solving these problems, and before referring to recent inventions by civilians, some allusion is necessary to the altered conditions which have now caused the general adoption of mechanical road locomotion. As stated by Mr. Worby Beaument in his valuable treatise on "Motor Cars," in the early days the railways absorbed all the attention and all the capital which the country could give to locomotive and transport questions, thus robbing the successes of early inventors of the support which was necessary to establish mechanical locomotion on common roads. Railways have now ceased to make material extensions either in length or as a means of distribution, and no longer offer the most attractive investments.

Secondly, the far-reaching influence and beneficial results of mechanical engineering have commanded attention in the House of

Commons, and the laws for the suppression of mechanical road transport have been repealed, fresh and more reasonable enactments have been passed, and to this the recent remarkable developments in road locomotion are greatly due. Thirdly, the improvements which have been made in machine tools now render accurate work not only possible but cheap, and from their general use has been derived the practical possibility of the modern high-speed engine, and now the engine which took up much valuable space in the road carriages of 1830 can be put in a small box on the fore-carriage, or slung out of sight on the frame.

Taking the problems I have mentioned in succession, the increase of radius of action was the first to be dealt with. To overcome this difficulty a traction engine was fitted with an air-cooled condenser. The engine constructed was of the heavy type. The condensation took place successfully, increasing the distance the engine could go up to 40 or 50 miles, instead of only 15, as is the case with an ordinary engine. But the condenser suffers severely from the jolting and jarring on the road, and its practical efficiency is liable to be lost. It is possible that in a smaller type of engine the condenser may be made sufficiently strong to stand the strain of road work, and enable an engine to travel about 50 miles, or even further, without requiring water. In addition to the increase of the distance, the engine could travel without taking in extra fuel and water; it was constructed with a view to, and obtained the following advantages:—

1. Silence in working.
2. High speed.
3. Absence of smoke and smell.
4. Ease in steering.
5. Motion dust-proof and out of sight.
6. Oil for lamp could be obtained in any town or village.

Having apparently arrived at the limit of radius of action which a steam engine can attain, it was thought that an internal combustion engine using a cheap, heavy oil would more effectively grapple with the problem. With this in view, a specification was issued, and a prize of £1,000 offered for an engine of this nature. One competitor only, however, came forward, prepared to build an engine of this class; this was the well-known firm of Messrs. Hornsby and Sons, of Grantham, makers of stationary oil engines.

The conditions of the competition were that the tractor was not to weigh more than 13 tons when loaded with fuel and water, and to be able to draw a load of 24 tons, including the weight of the wagons, for a minimum distance of 40 miles without requiring more fuel or water than that carried on the engine.

The engine Messrs. Hornsby built is not an older pattern converted or any patched-up arrangement, but is quite a new departure, and the amount of time, thought, and money expended by the firm in its construction is by no means compensated either by the gaining of the prize or the purchase of the engine.

This engine succeeded in obtaining a radius of action of 78 miles, and, with an additional tank of oil which can be fixed on the engine, can travel 100 miles. Of the total weight of the engine, over 10 tons are on the driving wheels, and under 3 on the front wheels, so that the maximum adhesion is obtained. The engine is of the ordinary Hornsby-Ackroyd type, having two cylinders one above the

other, the lower being horizontal and the upper one inclined so that its axis passes through the centre of the crank-shaft; the connecting rods of both are connected side by side to a common crank-pin. The cylinders are of the ordinary single acting gas engine type, each having its own vaporiser, oil pump, and valve motion, the timing of the latter being timed to give an explosion every revolution. The speed of the engine is governed by an ordinary bill-crank governor.

The cylinders are water-jacketed, and the water is circulated by a rotary pump through a cooler under the foot-plate.

The air for combustion is drawn from a silencing box in the upper part of the frame between the crank-shaft and cylinders, inside the box are arranged the ends of the air-pipes. The main exhaust silencer consists of a box in front of the frame, with which the exhaust pipes from the engine cylinders are lead. A chimney is placed on top of this box, and is constructed to form a second silencer.

The propelling gear is started and stopped by a friction-clutch, and the train starts easily without a perceptible jerk.

There are four changes of speed and reverse.

The levers actuating the changes of speeds, oil pumps, etc., and all the lubricators are worked from the foot-plate. It takes about half-an-hour to start up when the engine is cold.

The engine, as fitted, is suitable for using refined Russian oil, and can be adjusted to use refined American, Scotch shale, crude Russian, Texas liquid fuel, and Burmah oils.

The second problem is that of negotiating difficult ground; this nature of ground is of two styles: *a*. Hard surfaces, such as metal roads, where the difficulty lies in steep gradients and the greasy condition to which they are liable. *b*. Soft ground, whether it be country roads or the soft soil of the country and sometimes water-logged. Naturally the difficulty is increased where there are steep gradients.

The problem in the first instance is only one of power and adhesion. The power can always be obtained by using a suitable engine; but how is the necessary adhesion obtained?

In tractors and lorries there are only two wheels—the driving wheels—which exert a tractive effort; the rest of the wheels in the train are idle in this capacity, and, with the exception of the steering or front wheels of the tractor or lorry, the less adhesion they have the better, so long as they have sufficient to prevent slipping sideways or down hill. The whole adhesion, then, necessary for the power of the engine being converted into work, or moving the train or lorry along the road, must be found by the driving wheels alone, and this is done in two ways, namely, by placing as much weight as possible on the driving wheels, and by placing in their road strips. By these means gradients practical to other forms of traffic are negotiated. When hard surfaces are slippery the only way to overcome the difficulty at present is by doing away with the cause of slip by placing something under the wheels, such as sacking, etc. The second class of ground offers more difficulties, as it includes one of flotation as well as adhesion and power.

As I have already said, adhesion can be obtained by weight, but there is a limit to their manner of obtaining it on soft ground. We

find that the big, heavy engines of great power only break through the upper crust of the ground, and grind themselves in, and it takes some time before they can rope themselves out, or have baulks of wood placed under their wheels to enable them to do so.

Spuds, which resemble short strips of angle iron, are placed on the tyres of the driving wheels and act as a sort of paddle, and over many natures of soft surfaces are successful. But they by no means improve the ground for other engines or transport that may have to pass over the same ground. It was thought that a very light traction engine might give better results. With this in view a small tractor weighing about 5 tons, and capable of drawing a gross load of 5 tons, built by Messrs. Tasker, of Andover, was tried in the vicinity of the old "Supply Depôt," at Aldershot. The ground near the depôt was of a very variable nature:—

1. Rough road on incline of 1 in 8, surfaces of which were soft.
2. Low-lying swampy surface covered with water, mud and grass.
3. Slopes covered with coarse rank grasses, heather and gorse.

With a gross load of 2 tons, composed of an A.S.C. Bristol wagon and its load, the tractor pulled without difficulty over all the above ground. The load was then increased to three tons, and the tractor pulled successfully over the ground with the exception of the very short steep rise of 1 in 4, practically a bank, when the rod in the spring draw-bar broke, necessitating the load being roped up. The tractor was then tried over the low-lying swampy ground with a gross load of 4½ tons in the traction engine trailer. It successfully pulled over this ground; but when ascending a slope with a very rough and sandy surface, thickly covered with gorse, had to rope its load. So, then, it successfully negotiated almost every nature of ground likely to be met with in camps. The most notable feature in the small tractor is its power on grassy land. For instance, a big 19-ton traction engine without any load at all endeavoured to cross such a surface, and immediately ground itself in, while a small tractor with a fair load behind it accomplished it without even requiring spuds. It would therefore seem that an engine sufficiently light not to break through the crust or upper surfaces of the ground and able to divide its load, will be able to work in places prohibitive to heavier types, or over which lorries carrying their own load cannot pass.

But the capacity for traversing surfaces over which other engines cannot pass is not the only advantage the light tractor has. In addition, it can be easily man-handled, conveyed by rail or sea, and can pass over military bridges, or be rafted across rivers. But it must be remembered that these light traction engines are not comparatively economical in their fuel consumption, and some difficulty is experienced in keeping up steam. It will therefore appear that the transport tractor of the future will be a light internal combustion engine, using cheap, heavy oil, and efforts are being made to obtain an engine of this nature.

At the Automobile Exhibition in Paris last December, Colonel Renard exhibited a new method of transmission of power for a train of vehicles, by which he endeavours to deal with these questions.

The governing principle of this invention lies in the disposition, or rather distribution, of the motive power. Instead of making the first car the tractor, and using it in the ordinary way to haul the rest of the train, Colonel Renard transmits the rotary motion obtained from the ordinary petrol engine on the front car to each of the others in succession by means of a bevel gear and Carden shafting, thus making each car automobile, though not itself creating the energy it absorbs.

Many advantages are claimed for this arrangement. Use is made of the whole gross weight of the train for adhesion instead of obtaining only that produced by weight on the driving wheels of the engine. The first car need not be any heavier than the others, since it exerts no tractive power, further than is required for its own propulsion; there is practically no slip in starting or stopping, since each car has its own propelling wheels. The same principle has been carried out electrically in the United States, where a train of this nature is used for hauling borax at the Death Valley in California—the hottest place in *this* world. Details of this train are not to hand, but I imagine this system will save that power which must be lost when a mechanical means of transmission be employed.

Another invention which has been designed to grapple with the problem of the mechanical traction is the Pedrail. The following is a brief summary of the interesting description of this machine given by Professor Hele Shaw at Liverpool last year:—

The Pedrail.

Mr. Diplock, the inventor, has gone back to nature to seek for a solution of the problem of Mechanical Traction over all kinds of surfaces.

If one has studied the mechanical movement of a man, one will realise that when he walks he places his foot upon the ground as a support, and moves forward upon it by using the ankle as a pivot. The movement his body is thus able to make is strictly limited in amount; but nature has provided a means by which the movement can be made continuous. This is effected by means of another leg, which, being brought forward, enables the other foot to be placed in a position to carry on the movement of the body, whilst the foot which came down first is brought forward to the new position.

The plan upon which this is based consists essentially of a rolling movement, since rolling takes place by turning about some point.

If we now attempt to translate an animal mechanism into a mechanical device, it is easy to imitate the general principle of action by having a number of spokes radiating from the centre upon which the weight is carried. To make this movement mechanical and continuous, the simplest method is to carry the spokes round in a circle. Suppose we increase the number of spokes indefinitely, we get a circular disc, and substitute for a jerky and irregular movement the continuous motion of a rolling wheel. This simple explanation indicates the relation (from a mechanical point of view) between the action of walking and the rolling of a wheel, and it enables us to appreciate the relative advantages and disadvantages of both methods of locomotion. With the wheel, the whole surface to be moved over becomes in turn a point of support; and unless the surface is both hard and smooth, the

resistance which the wheel experiences is always appreciable, and may be very considerable.

The wheel can only act without appreciable resistance when it makes contact with the smallest possible amount of surface. When it moves on soft ground the motion is not one of true rolling at all, but an amount of slipping takes place, which bears a definite ratio to the depth of the rut left by the wheel, and may, in extreme cases, be so great as to render it impossible for the wheel to turn at all. A wheel on the road has an enormously greater resistance than a wheel on the railway, and, taking the average resistance given by various authorities, it may be said that on railways the resistance is, roughly, from 8 to 10 lbs. per ton, while on the ordinary turnpike road the resistance varies from 50 to 500 lbs. per ton.

Now, the Pedrail indicates by its name that it is a rail carried upon feet, and the principle of its action may be explained in a few words. It is simply this: Instead of having a permanent rail carried for the whole of its length on permanent feet, viz., sleepers, and the wheels running upon this rail, this process is inverted. The feet are (as in the case of the railway) placed upon the ground, but instead of the rails being carried upon the feet, these feet support wheels, and the wheels thus supported act as bearers for a short length of rail attached to the moving carriage.

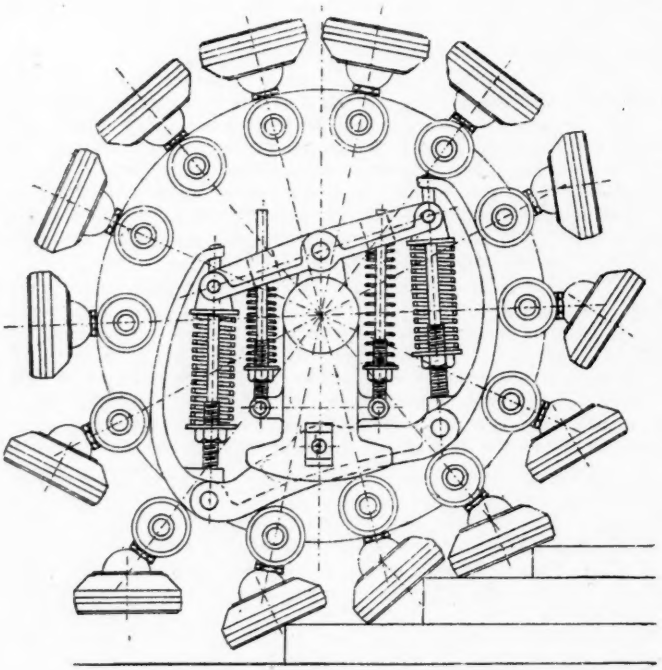
The Pedrail invention, however, does more than this. The feet and wheel which they support are attached to the moving carriage itself, so that by an automatic process the feet are carried round after the rail is moved over them, and placed again in front of the machine, thus affording a continuous track of wheels upon which the supporting rails can be carried in any direction in which the engine is steered. It is scarcely possible to make this invention clear without being able to show the actual machine itself at work.

Briefly, the invention might be described as replacing the wheels of an ordinary traction engine by revolving frames, carrying sliding spokes, each spoke having at its end a circular foot, and on the spoke itself, at a little distance above the foot, a small wheel or roller. In connection with each series of revolving spokes a fixed frame is attached to the side of the traction engine. This fixed frame somewhat resembles in form an inverted heart. When the axis revolves, the spokes are carried round and place in turn upon the ground the feet. At the same time, the wheels which run round in contact with the heart-shaped frame when brought underneath it (that is, under what may be described as the broader portion of the heart) act in turn as supports for the heart-shaped frame to glide over. Hence the engine is itself supported in turn, through the wheels, by the spokes, which happen at the time to be resting with their feet upon the ground.

The Pedrail consists of two parts, one of which is a railway which is fastened to the axle-box and does not revolve, and the other part is a kind of circular box carrying sliding spokes, rollers, and feet in such a manner that the rollers and feet are placed in succession on the ground, and the rail runs over them.

From the above a general idea may be formed of the principle of the Pedrail; but it requires careful study of this somewhat complex machine to appreciate the ingenuity which has been shown.

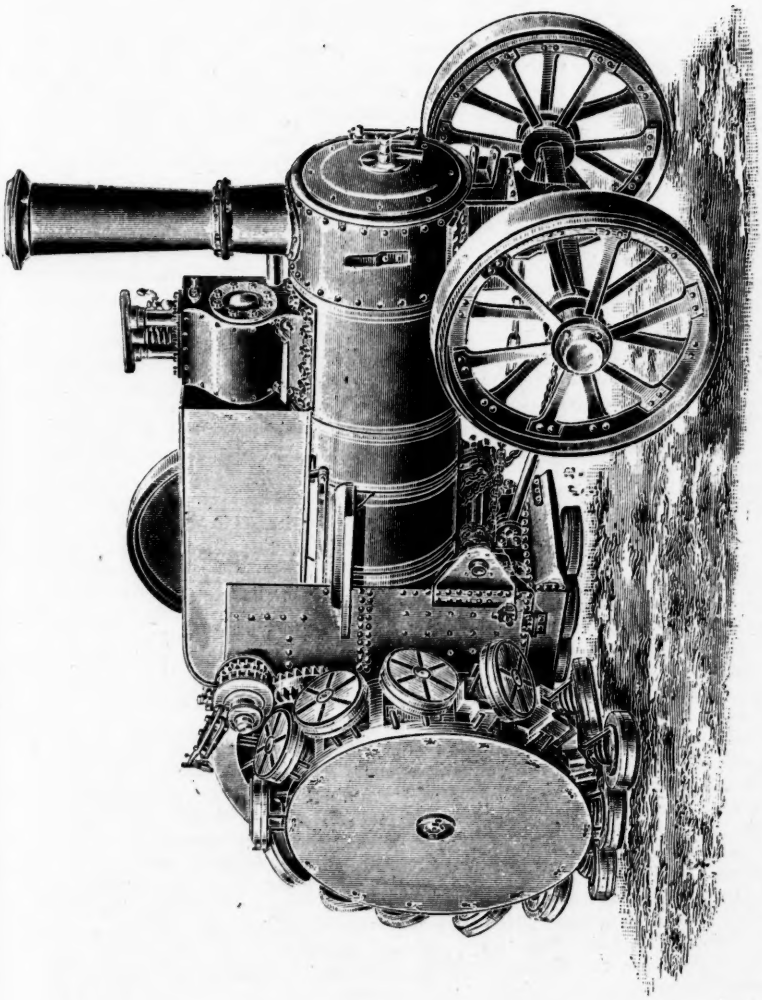
Time does not permit of a detailed explanation of the systems of the springs and sliding joints by which the spokes obtain the necessary flexibility of movement, nor of a description of the system of lubrication, which is the result of a vast amount of thought and ingenuity, since through one oil-hole the complete lubrication of the whole structure is maintained; but it may be remarked that the feet themselves are lubricated by being filled with a mixture of tallow and blacklead, and upon opening one of them after 12 months' intermittent work it was found to be in as good condition as the day it was filled.



SECTION OF PEDRAIL WHEEL.

The latest developments of the Pedrail is to place such wheels on the small tractor, to serve as driving wheels. Mr. Diplock considers an engine so fitted will probably traverse all surfaces that a wagon and 6 horses can negotiate.

Whether this remarkable invention will stand the test of time, and prove itself to be within the sphere of practical utility, remains to be seen; but its future must be kept in view by all who are interested in mechanical transport.



LIGHT TRACTION ENGINE, WEIGHING 5 TONS, WITH PEDRAIL WHEELS.

The CHAIRMAN (The Rt. Hon. Graham Murray, M.P., Secretary for Scotland) :—I shall only trouble you with a very few observations, because, although I was exceedingly glad to have the opportunity of coming here to-day and hearing the discussion on this subject, it would be idle for me to say that I have any knowledge or experience which would warrant me in pronouncing an opinion on some of the difficult problems we have heard discussed. I can claim no more than this: a certain amount of very practical experience of fighting with motors in both perfect and imperfect conditions. The interesting subject that we have had before us to-day is the use to which mechanical traction can be put in the operations of war. I think we may at once dismiss a subject which, indeed, was only incidentally mentioned by the lecturer—the use of the ordinary motor car for the purpose of manœuvres. When you come to war, it is quite evident that that problem is enormously complicated by the class of country with which you have to deal. It is impossible to compare the different countries in which a British force, at any rate, might have to operate, when you come to consider their practicability to motor transit. But I am bound to say that I am perhaps a little sceptical of the motor ever being used—I am not now talking of the transit of heavy goods, but the motor for the purpose of conveying troops—ever being found very useful except in what is more or less a civilised country, because the conditions with regard to a motor, when you come to a slippery and uneven surface, become so enormously difficult that it would be almost impossible, even if we had the more or less perfect machine that was outlined by the lecturer, to cope with the difficulties that might arise. With regard to his proposals for having a certain amount of motor infantry, I think it is evident that if you were dealing with a country like our own, or any country where roads are good, that it would be an enormous advantage over even the railways, wherever you come to the question of cross-country routes. Everyone of us knows that although the railway is still the quickest way of getting to London or any given point, especially that point which is far off, as soon as you come to a cross-country journey, no train can compete with a good motor. With regard to the lecturer's requisites for a car, I looked at them with great interest. I think there are people other than military men, who are searching for a car which has all the qualities which he asks for—in particular, an inexpensive and reliable tyre would be a source of gratification and joy to many besides the military expert. In looking at his list, I was very much reminded of an old picture of John Leech, of the "Horse Dealer," who, after going through all the various virtues of the horse, added that it was a moderate price; and then, when the customer said, "That is just what I want," he replied, "When I find it I will let you know!" With regard to the use of other spirit than petrol, I take it many persons are on that quest. It would be an enormous advantage, of course, not only to have a cheaper spirit, but a spirit which is more easily procurable in every place. I suppose it is really a question of carburation and of carburation alone; but that is easy to say, but not so easy to discover. Certainly, those who, like myself, have often, with the more volatile spirit, spent many a five minutes in that excellent occupation of turning a wheel, will have, at least at present, a certain doubt as to the efficacy of a less volatile spirit than petrol. The motor cycle was perhaps the part of the problem with which I, in one sense, have had most practical experience. There again, on country roads one could easily see that a body of troops provided with motor cycles would have a mobility which could not be touched by any other form of transit; but a motor cycle has its

troubles. The lecturer said it was now not at all a complicated machine. Well, it is a good deal better than it was, but I am not quite sure that its complications are all gone; and from my observations it is not a very uncommon sight to see a person on the roadside with a motor cycle who is in obvious temporary trouble! I also wondered to myself whether the lecturer had had the personal experience that I have had when he talked about the motor cycle being easily pedalled. The pedalling of a motor cycle is a thing that would very well do for military discipline, and indeed any form of discipline — I do not know of any harder form of work; but at the same time, I am rather inclined to agree with the conclusions that he arrived at, namely, that the motor cycle is such an easy form of transit that its use could not profitably be excluded in the military arrangements of the future. That brings us to what was really the chief part of his paper, and on which I do not feel that I am at all competent to speak. It is quite evident that mechanical traction for the transit of heavy stores and also, perhaps, to a certain extent, even of guns, has a great future. I thought one other suggestion made by the lecturer was excellent, namely, that in the case of guns, you might avail yourself of both forms of transit, and that while using the mechanical transit for the long hours of heavy labour where that was possible, you might at the same time with perfect ease reserve to yourself the greater advantages of the horse, which you could call to your aid in the last conditions of difficulty when you were in action, and when you might be at a place where motor transit would be practically unavailable. I should think it very far from my duty if I stood in the way of other people, especially as I am sure we should like to hear a few words from the author of the being of that hideous practical animal that we have just seen; it seems to get over one of the difficulties of surface which was a stumbling block in the way of the ordinary wheel. I will conclude by saying that I hope I am expressing the feelings of everybody when I say how interesting I have found the paper, and I hope it will give rise to a practical discussion by those who know something of the subject.

Captain J. N. C. KENNEDY, R.E. (Superintendent of Workshops, Chatham):—I must congratulate Major McNalty on the amount of detail contained in his lecture, and in the interest shown by his audience. He has covered the ground very completely as regards transport requirements, but I would like to supplement a few remarks on the technical application of motors and motor vehicles to military engineering. The internal combustion engine, owing to its light weight for power developed, is well adapted for employment in the field. All the fuel carried is utilised, and the machine requires no water, which is the great difficulty where steam engines are used. This system of obtaining power and transport is now being employed for the field search-light and wireless telegraph service with satisfaction. The experience of South Africa and the last manœuvres goes to show how useful portable light installations are. The lighting of temporary railway platforms and depôts will enable work to be carried out which would otherwise be impracticable. For field workshops a better means of providing energy could not be devised, and for hospital work, charging accumulators for Röntgen Rays apparatus, driving fans, etc., small engines would be invaluable. The application of motors in war will in the future undoubtedly be large, but at present the utility of motor cars is being recognised in connection with staff work at home in preparing the Army for war during peace. For this purpose I think the

formation of the Volunteer motorists was a very practical movement. Our senior officers are being shown how very efficient motor cars can become when properly used in the hands of skilled drivers. The only charge that can be laid against Colonel Mark Mayhew, whom I see present, is that his men are too efficient and make too good a show altogether, so much so, that many of our generals have received the impression that the cars run by themselves without attention. The Volunteer movement should be extended and developed as regards cars, but more especially motor cycles. It is in this direction I feel certain that a great future lies before the motor vehicle in its tactical application. Personally, I cannot foresee that a car will ever be brought under fire with advantage, but there appears no reason why the cycles should not be used in the first line. I would suggest the following as a rough idea for a unit, which, I think, would be most valuable :—

20 Motor cycles 40 Ordinary cycles	Rifles.
2 Cars	Repairing stores, ammunition.
1 Lorrie	Transport.

This would be a self-contained body capable of operating wide on the flanks, making detours of more than 100 miles if necessary. The operations would be largely governed by the existence of roads; on the other hand, the mobility would more than compensate by affording great choice of route. On the march the motors would each tow two ordinary cyclists, who would assist by pedalling up steep gradients, and if a motor should break down the cyclist could render assistance. The cyclist would also be able to assist the motorist over hedges and across country if necessary. For line of communication and station work, while active operations were not in progress, the employment of this unit would effect an enormous saving of time and horseflesh. During the recent manœuvres I found motor cyclists absolutely invaluable in superintending transport when spread over a long length of road. The delay occasioned by the engines stopping to take in water at every public-house was minimised. There are many people both in and outside the Army who are waiting for the motor car to become more simplified before identifying themselves with the movement. It is very desirable that such persons should have plenty of spare time on their hands, as they may have a long time to wait. The tendency in all modern improved appliances is to make for efficiency, not simplicity. The present type of traction engine is twice as complicated as that of twenty years ago; at the same time, it is four times as efficient. Our best policy now would be to adopt the existing types of machines and train our men to drive them properly. We should not waste time in endeavouring to obtain something that can be "easily repaired in the field," but rather to make our drivers sufficiently skilled as not to break them down. It may be very satisfactory to effect a smart roadside repair, but it is better to avoid it altogether by good driving. The motor cars of to-day are as nearly perfect as they are ever likely to be, but we have not got the perfect driver by any means. In my experience, I should say that 90 per cent. of the "breakdowns" are due to the drivers, not the cars. I disagree with the lecturer as to the necessity of introducing a standard pattern car. It would be very convenient to have everything interchangeable and of a fixed pattern, but standardisation tends towards laziness and inefficiency, want of progress, and general stagnation. One might as well try to adopt a sealed pattern for a lady's hat as for a motor car. In a few years we would find the Ordnance Stores fuller than they now are of out-of-date appliances. Petrol offers

so many advantages as a fuel that it is bound to be adopted, and, as far as we can see, the supply is not likely to diminish during the next 50 years. The danger connected with it is largely imaginary, and the disastrous fires and explosions that were predicted on its introduction have not as yet taken place. Under certain circumstances, it is more safe than paraffin. It requires a flame to ignite it, a lighted cigar may be dropped into it with impunity. The sea carriage of petrol requires care, as does also its transport by rail, nevertheless, we see civilians engaged in peace time conveying it to all parts of the world, and why should not soldiers be willing to undertake the so-called risk in war? As regards "silence," a noisy car has the advantage that it does not come on you unawares, and as motor cars should have no business in the picquet line at night, it should not be debarred on that account. When you approach the enemy so close that he can hear the car it is time to stop the engine and get underneath. Half the troubles of motor cars arise from the rubber tyres, but of these quite 80 per cent. are due to pure ignorance or neglect. I have classified 53 common causes of failure in pneumatic tyres, of which 46 are easily avoidable, and with special care most of the remaining 7 need not be encountered. To my mind, solid tyres possess no virtue whatever, except in the case of very heavy vehicles, although they are not liable to punctures. I have in my charge three cars shod with the former description of tyres, which have been subjected to heavy work since last January without having experienced a puncture.[1]

Colonel EUSTACE J. A. BALFOUR, A.D.C. (late 7th Middlesex V.R.C.):—I welcome this lecture very much indeed, because I myself have been, I may say for years, a voice crying in the wilderness trying to bring this very subject forward. Perhaps I may be allowed very shortly, not to controvert anything that the lecturer has said, but rather to try to supplement it from my own small experience. The first point I would like to raise is the one to which both the Chairman and the last speaker alluded, namely, the tactical employment of motor cars. I was Chief Staff Officer to Major-General Sir Frederick Maurice during the cycle manœuvres two years ago, and we came to the conclusion then that the combined use of cyclists and motor cars—I am referring now to ordinary cycles rather than to motor cycles—might, in certain circumstances, be extremely valuable. The essential use of cycles tactically is the employment of a force which is absolutely independent of base. You must be able to send them round any distance you like, and they must carry with them, in some form or another, all the stores they require, more especially the stores of ammunition. Suppose, for instance, that an army corps, or two army corps, were to land in this country, we should be at an enormous advantage if, by a turning movement of 100 miles, we could send a battalion of cyclists, supported by a certain number of motor cars, and hit their baggage train. The cyclists could scarcely do it themselves, because they would run short of ammunition rapidly, but, combined with motor cars, I believe they would be a most valuable force. To show what could be done in this way, I may mention that we had, on Saturday week, the ninth annual competition for what is called the Wolseley Cup. The competition consists of teams of cyclists riding 40 miles, at an average of 10 miles an hour, and then firing at figure targets, the object being to test the power of firing after a long ride. The four highest scores were all over 100, one being up to 115, out of a possible 160; it shows how valuable

[1] September—No punctures to date.—J.N.C.K.

they should be regarded. To come now to traction engines, in my battalion, during the last four or five route marches we had through Scotland, we always employed steam traction. One or two advantages struck me very much indeed in that experience. The first is the enormous simplicity of the traction engine wagon and the trailer, as compared with the cart when it comes to loading and unloading. We could get our camp pitched, when we were unloading a traction engine transport, in less than half the time we could when we were dealing with horse traction. When you come to think how very important every half hour's rest that the men get in each day is, that is a very valuable point. But we did find in certain cases that we could not use steam traction. The last march we had was from Aberdeen to Blairgowrie. That route goes over the highest pass in Scotland, one of General Wade's roads,[1] and the county road surveyor absolutely refused to give us leave. It was not so much the difficulty connected with the bridges and culverts, because that can always be got over, as you easily might with a party of engineers either by strengthening the bridges or giving a wide bearing; but the danger that you have, when you have a road like that on the side of a hill, is that the whole thing will slip down; and there is no possibility of getting over that difficulty. So when we came to a place like that we had to revert to horse traction, which, of course, would not be done in war. Another point which I think would be very well worthy of consideration is to make steam traction bullet-proof. Horse traction is probably one of the most vulnerable things it is possible to have, but if these wagons and locomotives are even partially bullet-proof, the baggage guard could be mounted, instead of having to march by their side, which would delay the speed of the engines and trains, and it would be practically invulnerable to anything but artillery.

Lieut.-Colonel R. M. F. KELLY, D.S.O., R.A. (Chief Instructor, School of Gunnery, Shoeburyness):—I am very glad I was able to be present this afternoon to hear the very interesting paper that Captain McNalty has read to us. A few months ago I had myself some experience with the old pattern engine, so I was very glad to hear the lines on which development is progressing, by which the difficulties which I have myself very often experienced, chiefly difficulties arising from slippery chalk roads, going up steep hills, and from the slipping or skidding of the engine on soft ground, may, I hope, be overcome. From what the lecturer said, the development appears to be going on two rather distinct lines, namely, in the Hornsby engine they appear to be going for a greater radius of action, silence, and absence of smoke. Those are three things which are of vital necessity for an engine that is to go into the fighting line in times of war. In the second case, the light engine—I did not catch the name of it—the development appears to be going on the lines of overcoming the tendency of skidding on soft ground. The heavy engine can, under certain circumstances, overcome the slipping on slippery steep roads, but it gives way on soft ground; and the heavier the engine the more it, as it were, digs a grave for itself in the ground, instead of hauling its load on. I did not gather from the lecture that these light engines also share the advantage of the Hornsby engine in having a very extended radius of action, nor share the advantage of

[1] Readers of Scott will recollect the Irishman's description of these roads which were part of the great "Blockhouse System" after 1745: "If ye'd seen these roads before they were made, ye'd have held up your hands and blest General Wade."—E.J.A.B.

noiselessness and smokeless fuel. I think there is no doubt that the present attitude of artillery officers, or at least that portion who are at all concerned in thinking of the means of traction for heavy guns, is that the time certainly has not arrived in which you could safely entrust your first line, that is to say, your guns, and your first line of ammunition wagons to mechanical transport. It does not, however, for a moment follow from that, that we have no interest in the development of mechanical transport, or that we, as it were, despise it and think it is a thing that has no concern for us at all. I think that at the present moment mechanical transport could be used in three distinct ways, short of being used actually for bringing guns into position. I think it could be used, firstly, for the transport of the second line of wagons and for the ammunition column. I take it that each gun would be accompanied by at least two ammunition wagons besides the ammunition column. The first line of wagons, I think, should be horsed, or provided with animal transport, as also the guns. Secondly, I think mechanical transport might possibly be used as adjuncts to help at a critical point. I think one of the greatest advantages mechanical transport has over animal transport is the power of sending your engine right up a difficult place, or to circumvent a difficult place, and then, by means of haulage as a stationary engine, to utilise its enormous power in pulling the guns up. That is an advantage which you can never get from horses; there are no means of sending your horses on and getting them to turn windlasses that will pull your guns up. The third way in which they can be used would be to use them day by day for the coolie work—I think someone before me has mentioned this—of hauling your guns over the roads, and thus saving your teams of horses to be used for taking the guns from the road to their place of action, and, if necessary, taking them, not at a rapid pace, but perhaps at a quicker pace than the four miles an hour that you would expect to get out of your traction engine. That, of course, would be a rare luxury and a great advantage, but it would mean duplicating your haulage power, and necessarily increasing the expense. In that way it would have to be a question as to whether the money could not be more usefully spent on other things; but there is no doubt that if it were spent in that way it would tend to promote the life of your teams, which are most difficult to replace. I should very much like to know if the lecturer could give us a sort of rough comparison between the fuel that is consumed by an engine and the corresponding weight of food necessary for animal transport of a battery. Take a horse transport of eight horses to a gun and four to a wagon, you would want for one gun and one wagon about 240 lbs. of forage a day. Touching that point, I would also like a comparison between the ease of replenishing or conveyance of the forage for the horses and the fuel for the engine. The other point on which I should very much like a few words would be the comparison of vulnerability of the two things. Take the effect of a certain amount of fire on an engine, how far it would be possible to repair the engine in the field. If the engine could not be repaired, you lose one gun and one wagon, whereas the same amount of fire might only put one horse out of action, and you can still get your gun on, even if two horses were put out of action, or, perhaps, for a short distance, even more. So that the thing to be thought of with regard to the traction engine is that you have rather got all your eggs in one basket, compared with a team of horses, in eight baskets. Those are the points on which I should very much like a few remarks from the lecturer.

Colonel R. E. B. Crompton, C.B., R.E. Vols. (Electrical Engineers): — I think the point that has now been raised by Colonel Kelly is the real crux of this matter. If our guns are to be taken into action by mechanical power, it is of first importance that we do not put all our eggs into one basket. We must have many hauling engines, and these must be small ones. By so dividing up our engine power we gain several of the advantages mentioned by the lecturer; first by using light instead of heavy engines we can work over more difficult ground, as much of the ground may be which must be traversed by artillery; although it may have a hard crust, this crust is easily cut through by the wheels of heavy engines, so that much of the power of the engine is expended in moving itself over such soft ground. With engines light enough not to cut through the crust this difficulty does not occur, at any rate, not to the same extent. As previous speakers have said, the problem of dealing with the fighting line is a far more difficult matter than that of supplying stores to the second line; but I think we ought not to say that we must abandon the idea of taking mechanical hauling engines into the fighting line. This matter is very parallel to the use of steam in our war-ships. I am old enough to remember the Crimean War, and recollect our sailing battle-ships being taken into action for the first bombardment of Sebastopol by steam frigates lashed alongside them. We then commenced to put engines as auxiliary power into our sailing war-ships. Gradually the steam power was increased, the sails became the auxiliaries, and now we see their use finally abandoned. I believe that mechanical means of haulage will follow on the same lines, and very wisely so. We have already applied it in the easier operations of supplying the second line, and it did yeoman service in South Africa, as everyone will testify. The lecturer has pointed out that what kills and strews the theatre of war with the carcases of the animals is the heavy slogging day-to-day work of dragging the loads to supply the second line, and this is the work we must tackle first, and even now are able to carry it out efficiently by mechanical transport. The requirements for this class of haulage are not difficult, although they vary for different countries. As one speaker has already said, there are two distinct requirements open to us, one being long radius of action or the power of moving great distances from the fuel and water base, and the other that of manœuvring with our engine in difficult ground. These two requirements are not incompatible, although of course, long radius of action is somewhat easier with larger and heavier engines, but small and handy engines with a sufficient range of action can now be designed. As regards manœuvring engines in difficult ground, a great deal depends on perfecting the winding gear. The use of the winding rope, which has a most important function to perform, has been very imperfectly developed up to the present time. It causes a serious delay to stop the engines and get the winding gear to work; this ought not to be the case. It can be so arranged that the driver can stop and change from direct haulage to winding his load in a few seconds of time. The next important feature is the perfecting of the driving wheels, for although we all admire the beautiful invention put before us by Mr. Diplock, and all wish him success, his invention appears to me to entail considerable complication and difficulties of repair in the field; but for the present I think we must look for great simplicity in the wheels. What we require are wheels of large diameter and considerable width of tread without the great increase of weight which has been always considered necessary in the wheels of the traction engines of commerce. Commercial engines cannot pay for refinements in these wheels, but I

believe that as we have now such very perfect materials at our command, such as oil-toughened nickel-steel, wheels of the traction engine type could be designed far lighter than they are at present, and this is a line of improvement which those responsible for the design of military hauling engines can safely follow. It is not too much to say that the chief difficulties met with by the driver of a military hauling engine are due to insufficient diameter or width of his driving wheels, and practically the same may be said of the modern motor car, which fails to be useful for transporting officers and men over heavy ground simply because the modern motor car has been designed with small wheels fitted with pneumatic tyres, which diminish the vibration on good roads, but which are useless to go across country where there are many ditches and depressions in the ground; these can be only satisfactorily crossed by wheels not less than 5 feet in diameter.

Sir J. THORNYCROFT, F.R.S.: — I do not know that I can enlighten the meeting very much on this subject, but I do feel it is one of great importance, and one in which, as Colonel Crompton said, we have to look forward, not only to the secondary work, but working right in the front. For myself, I have had a good deal of experience in engineering, and I have had considerable experience in motor-car driving, and when I compare my own legs with what I can do on a motor car, I feel that ordinary animal traction is not well adapted for getting over the ground if you want to do it rapidly. In war, the difficulties are great, and it has been stated that it will be in civilised countries only where mechanical traction may perhaps be used with much advantage. But I take it that it is in countries where there are roads that it is most important we should hold our own; we should be well prepared for countries well fitted with roads, and there is not the least doubt that where there are roads mechanical traction can beat any traction by animal power, no matter how good your horses may be. The question before us is one that has been solved in several ways. The earliest development of mechanical traction was by means of a steam engine. The steam engine has this disadvantage when compared with an internal combustion engine: In the steam engine you have a large system of pipes and vessels, all conveying material under high pressure, and any failure of any part of the machine subject to pressure may make it very difficult to repair that machine in a short time. The internal combustion engine has the advantage of using less fuel. It is also, in many of its simplest forms, only subject to internal pressure at the time the pressure is wanted and in that particular place in which it is required. The pressure is an instantaneous thing in the working cylinder, and that simplifies the matter enormously with regard to repairs, because the ducts that carry the fuel, gas and vapour are only subject to a very limited pressure. I remember with much pleasure the incident where a car broke down, and the tube conveying the gas from the carburetter to the cylinder was broken, but in the course of two or three minutes a pocket handkerchief was wrapped round the tube, and the car became workable again. That is a great contrast to the steam engine. With regard to the use of paraffin compared with a very volatile spirit, some people are of opinion that volatile spirit is much more dangerous, but there is one reason why it is not. Volatile spirit has the property of being dissipated through the air and being conveyed right away, so that if you get a leak in a place where there is a circulation of air no quantity of oil accumulates, whereas if you take ordinary paraffin, and there is anything of such a nature as will soak it up, you may get a large accumulation, which will

greatly increase until it becomes a source of very considerable danger. But I would not like to argue that paraffin is a more safe thing to carry. My firm has made experiments on the matter, in which we have been successfully working with ordinary paraffin. That certainly has an advantage. There is, of course, more difficulty in starting an engine where you use the ordinary paraffin; but I do not think it is insurmountable, and I trust that this problem will be solved. I do not think I will say more, except to thank the author for the paper which he has brought before us, and to say that I think the subject is of very great importance.

Captain J. H. Dickson (Mechanical Transport Officer, Quetta District): — The difficulty with the steam engine that has been experienced in working at Quetta, which is the only place in India where we have used it, is, as Sir John Thornycroft says, in connection with the repairs. When you have to make a roadside repair, you very often have to let down steam before you can carry it out, which means a loss of some four or five hours,whereas in the internal combustion engine you have no steam to deal with, and you can set about your repair at once. I find wherever I go I have to make my own roads or greatly improve the existing tracks. It is not sufficient to say that where there are good roads mechanical transport can work; but they must be able to work over any country, and with this view I am inclined to suggest that we should have our traction engines supplied with sets of road roller wheels, so that when on service, roads for mechanical transport can be made, just as it is recognised has to be done for mule, camel, or cart transport. I think if this is done, and we get a certain number of pioneers, or sappers and miners, to assist us in making roads for our mechanical transport, we shall then, and not till then, work well and economically over countries that have no roads at present.

Major McNalty, in reply, said:—A great many points have been raised in the course of the discussion, and I will try and reply to them in order. The Chairman says that an inexpensive and reliable tyre would be a source of gratification to many besides the military expert. In the private motor car of to-day, both these conditions are sacrificed to comfort and ease of running at high speeds, but in the military car the condition of reliability or freedom from delays due to tyre trouble, even with the best form of pneumatics, must be the primary one, and this condition, in conjunction with that of cheapness, both in first cost and upkeep, will doubtless be complied with by some form of wheel whose resiliency will be obtained by means other than that of placing between the rim and the road a cushion particularly susceptible, not only to wear and tear by friction, but to be rendered temporarily useless through puncture. At present everything points to solid or semi-solid tyres as being most suitable for military purposes; and were more attention paid to springing cars, and the legal limit of speed never exceeded, no doubt these would prove quite as comfortable as pneumatics. I said that a motor cycle could be pedalled should the engine fail, and this is, I consider, an advantage which the cycle has over a car, but I am not prepared to say it is easy work. In any case, a total breakdown may often be avoided by this means. With regard to the use of a heavier oil than petroleum spirit, the many advantages of the former are obvious, and I agree with Sir John Thornycroft in hoping that the problem will shortly be solved in a satisfactory manner. In reply to Colonel Balfour's question as to what extent traction engines

were bullet-proof, I have a slide which shows the effect of bullets fired from 400 yards range at a locomotive. It is an interesting one, and, I think, clearly demonstrates the invulnerability of a traction engine to rifle fire. Captain Kennedy said that petrol offers many advantages as a fuel, and in motor cars perhaps its cleanliness and the absence of any disagreeable smell may be advantages, but for the heavier types of machines ordinary commercial paraffin is cheaper, more easily obtained, more easily stored, and, if the carburation is suitably arranged, gives more power for equal bulk than petrol. I cannot agree with Captain Kennedy that the danger connected with the use of petrol is purely imaginary. I could instance numerous cases where disastrous fires have occurred, and these are rare where paraffin is employed. I said that machines must be easily repaired in the field, not meaning that efficiency should be sacrificed to simplicity, but that everything should be accessible and capable of removal with the minimum of labour. Many otherwise well-designed machines fail in this important respect, and in order to economise space parts are crowded together so as to render the removal of one, without the dismantling of the greater part of the machine, a matter of impossibility. Captain Kennedy also disagrees with me on the point of standardisation of cars. The object to be attained is efficiency as a whole, not that of individual cars, and this can only be done by standardising. Though the cars may not be of the latest pattern, the interchangeability of parts and the comparatively small quantity of spare parts which need be kept are obviously of paramount importance on active service, and it must be remembered that mechanical transport is for practical and not experimental work. Lieut.-Colonel Kelly asks for a comparison between the fuel consumed by an engine and the corresponding weight of food necessary for animal transport of a battery. One engine would be required to replace 12 horses for the transport of one gun and one wagon. Taking the greatest average distance that would be travelled per diem at 25 miles, the fuel required for an internal combustion engine would be 5 gallons of petroleum, weighing under 100 lbs. and being under two cubic feet in bulk. The forage required for 12 horses, using the most compact form of forage, would be 240 lbs. in weight and nearly 5 cubic feet in bulk. The attached table shows the comparison more clearly. Every day that the gun does not move makes the balance in favour of the engine greater.

Table Showing Comparative Weight, Bulk, and Cost of Fuel or Forage for Transport of one 4·7-inch Gun and one Wagon.

—	Greatest average distance travelled per diem.	Fuel or Forage used.	Total weight Fuel or Forage used per diem.	Bulk of Fuel or Forage.	Cost of Fuel or Forage.
Internal Combustion Tractor	25 miles.	Paraffin	50 lbs.	1 cub. ft.	20 pence.
Horse Transport...	25 miles.	Compressed forage.	240 lbs.	4·84 cub. ft.	234 pence.

Major-General Upton Prior:—I would like to propose a vote of thanks to the Chairman for his kind attendance to-day. Parliament is very busy now, and the Ministry, and our Chairman happens to belong to both, and

I am sure we are most grateful to him for giving us the advantage of any of his spare time. I think the interesting lecture we have had to-day and the discussion which followed show the great importance that mechanical transport is to any Army. One can imagine the amount required by modern Armies if you consider the front occupied by the Japanese Army now—something like 150 miles, with three lines of communication going from the front to the rear, each some 70 or 100 miles long. I think they would be very glad of some of those little carts of which we saw photographs on the wall. It only shows that in any estimates submitted in future by the War Office to the Chancellor of the Exchequer, a large sum for motor transport must be included, and I think we are fortunate in knowing that any estimate like that will meet with the sympathy of our Chairman.

THE SOUTH OF ENGLAND AS A THEATRE OF WAR.

Some Incidents Affecting the Tactical Employment of the Three Arms in the Southern Counties.

By Captain J. W. E. DONALDSON, R.F.A.

Topography.

BEFORE discussing the possibility of modifying the generally-accepted rules for the tactical employment of the three arms, it is desirable to enquire what are the special features of the terrain of Southern England likely to affect tactical considerations? The general nature of the southern counties is a much-wooded and closely-cultivated country, rising in places to bare "Downs," which usually afford strong natural positions with more or less vulnerable flanks. Entering further into detail, it will be found that the special features of the country affecting military considerations are:—

Roads.—Good and very numerous, but differing from those of other countries, in that they are usually devoid of any unmetalled space alongside, and are bounded by high, stout fences on steep banks, rendering deployment from the road difficult. Gradients are numerous and often severe.

Rivers.—Considerable rivers there are none. Streams fordable with difficulty by infantry, and affording serious obstacles to the other arms, are very numerous.

Woods.—These and trees restrict the view almost everywhere. Of the former, two types predominate: *a.* Extensive fir woods without undergrowth; *b.* Pheasant covers with thick undergrowth.

Railways and Telegraphs. — These intersect the country in all directions. In event of invasion these would confer certain strategical advantages on the home forces, but they seldom are factors of any importance in questions of tactics.

Towns and Villages.—The great number of small country towns and considerable villages is a very distinctive feature of the country. Large bodies of troops can be easily billeted in small areas. Supplies are unusually abundant, as are cattle, country wagons, and draught horses.

Cultivation.—The country is closely cultivated. Fields are small in the valleys, larger on the slopes, running to 20 to 40 acres near the downs. Hedges everywhere have banks and ditches, and are high and stout, forming ready-made entrenchments.

Infantry.

Having thus set forth the particular features of the terrain under consideration, it is now proposed to investigate what modifications, if any, of the books of training of the various arms, appear to be indicated as desirable under the above special circumstances. Taking first "Infantry Training," the general principles therein enunciated call for no modification, but the execution of these principles will demand some deviations from the prescribed forms. In the first place, the question of hedge-to-hedge fighting does not seem to have been considered. There can be little doubt that the infantry combat will resolve itself into sanguinary struggles for successive lines of hedge, each in itself a ready-made entrenchment, with an excellent field of fire for a short distance. Then, again, infantry fire will be opened at the most desirable ranges, as other ranges will be prohibited by the restricted view inseparable from a close country. These two factors appear to necessitate a strong and little extended firing line, with supports close up, an arrangement considered feasible by the abundance of cover. A feature of fighting in close countries has been, and will be, the frequency of local surprises. Under modern conditions, these would probably take the form of unexpected flanking fire delivered at short range from some unseen and unsuspected small, strong, tactical locality. For example, the defence might hide guns in the flank face of a cover screened from hostile artillery fire. The sudden opening of rapid Q.F. fire on the temporarily exposed flank of an attacking line of infantry would have the most decisive local result. Moreover, it might be some considerable time before the supporting guns could be informed of the state of affairs, and still longer before the hidden guns could be located and dislodged. Long lines of attacking infantry would experience exceptional difficulty in maintaining both touch and direction. The variation in the opposition experienced in different parts of the field would certainly result in offering the enemy opportunities for local counter-attack. As has been already pointed out, supports in a close country would be close up, and it appears likely that these counter-attacks would overwhelm both firing line and supports—*e.g.*, the French counter-attacks in the Niederwald at Wörth. Some provision, therefore, in the way of numerous local reserves to meet and repulse at once these local counter-attacks seems desirable. On the defensive, the system of occupying a long, thin line, whilst retaining the main force in a position of readiness in rear until the point of attack is known, is not altogether devoid of an element of danger. Close country and stout hedges are not conducive to the rapid movements of troops to a threatened point, and as the attack will often be able to approach quite close under cover from view, it may happen that the defender will find a portion of his position carried before the full garrison intended for it can come up. A corollary to this is that extended positions in a close country are dangerous unless there is a second position in rear which can be strongly occupied when the enemy is definitely committed to a known line. In other words, it may be deduced that in this country the advantages of a false front may outweigh the disadvantages.

Both in attack and defence the control of the fight, once units are launched, will be lost to their commanders, and it will become a matter for the most subordinate commanders. If an engagement is to have any coherence, all officers and non-commissioned officers must

know, not only the objective of their own particular unit, but also the general tactical idea underlying that objective, and the part to be played by other units in their vicinity. A noticeable feature of fighting in close country, strongly evidenced in both the War of Secession in the United States and the Franco-German War, is the tending of abundant cover to absorb very large bodies of men in very small areas. This may be attributed partly to the facilities afforded to skulkers, and partly to the necessity of numerical strength if men are to be persuaded to leave one bit of cover in order to gain another.

The system of ammunition supply is perhaps not altogether the best suited to the description of country under consideration. Firstly, it will almost invariably be necessary to detach the small arm ammunition sections from the ammunition columns and form men into divisional small arm ammunition reserves. The S.A.A. carts of the brigade ammunition reserves will have the greatest difficulty in following their brigade across country. It is not easy to see how the system of sending up full, and taking back empty carts, is to be carried out when there is not a road available. Even then it is unlikely that the road will be broad enough for the up and down flow, especially as it will not be possible to reserve a road for other military traffic. It is suggested, therefore, that a percentage of spare pack animals be with each S.A.A. Reserve, and that the ammunition be sent up on these animals, which would return at once empty. The ammunition mule in a mountain battery carries 367 lbs. all day and anywhere. Consequently it may be assumed that a good average mule would carry 300 lbs. of S.A. ammunition besides his saddle for the short distances required.

In conclusion, it may be pointed out that the infantry fight will resolve itself into a series of sanguinary struggles for tactical localities, and that therefore the general trend of the modifications to be employed will have in view the reduction to a minimum of the great delays and slow progress due to heavy losses and physical exhaustion. It seems probable that it will nearly always be necessary to arrange for fresh troops to carry on the advance from the capture of one tactical locality to that of another.

Cavalry.

The opportunities for shock action will be few and far between. The successful charge of the 1st Cavalry Brigade in the Army Manœuvres of 1903 was an instance of such opportunities, but it must be borne in mind that a very distinctive feature of Southern England is the great number of hollow roads and lanes. In very few places is it possible to move 1,000 yards in a straight line across country without encountering a hollow road or other obstacle sufficient to throw into confusion any but the smallest bodies of mounted men if moving faster than a trot. The effect of the hollow road on the French charge at Wörth is a good example of the confusion and disaster caused by such obstacles. On the other hand, the power and value of dismounted action will be much enhanced. This enhancement will be particularly effective when cavalry are employed to guard the flanks, both in attack and in defence. In both cases not only will the G.O.C. receive timely notice of the impending flank or counter-attack, as the case may be, but his cavalry, by their dismounted action, will be able to sufficiently delay the enemy so as to ensure the General ample time to make his necessary dispositions. Further, in order to

drive his cavalry, his enemy will probably be led into premature deployment, and the consequent frittering away of strength. Not the least important of cavalry duties is that of reconnaissance and obtaining information. When hostile cavalry screens come into contact the result will generally be a deadlock. Under modern conditions and by prescribed methods it will not only be most difficult to ascertain whether the enemy's infantry is present or not, but also it will be most difficult to assess his numbers with any degree of accuracy. Our experiences in South Africa have shown what a display can be made by a few mounted men, given modern rifles, smokeless powder, and good cover. It seems that the only way to overcome this difficulty would be to utilise the individual intelligence of specially trained officers, non-commissioned officers, and men, working in very small parties, such as two or three men, whose special duty would be not to fight, but to obtain information at all hazards. Such patrols would undoubtedly be often captured, but the information brought back by the few who escaped would be invaluable. The system of regimental corps recently inaugurated in the Ist Army Corps is intended to supply this deficiency, and the men are trained on the lines indicated above.

Cavalry is essentially the arm of the pursuit. In the pursuit it would endeavour to utilise mounted action, but the close and intersected country, coupled with the powerful stopping effect of the rifles of a few resolute men, will probably induce the cavalry commander to endeavour to head off the retreating infantry by moving rapidly along roads round their flanks, instead of pursuing directly across country. On the other hand, the difficulties of retiring rapidly across country, and the existence of suitable roads near at hand, would be very conducive to demoralised infantry making for those roads in confusion. Stonewall Jackson's cavalry at Front Royal demonstrated what can be effected by cavalry charging down a road crowded with fugitives, and it is clear that the decisiveness of that effect cannot fail to be enhanced when the road is bounded by high, stout fences.

Mounted Infantry.

If mounted infantry are used as cavalry they will suffer from the same disabilities as that arm, accentuated by inferior training and horsemanship. But it is assumed that they would only be utilised when cavalry was not suitable. No commander would care to sacrifice the power they confer of rapidly transferring infantry fire from one part of the field to another. It is clear that they would be invaluable for such duties as securing a tactical point seized by the cavalry, covering the retirement of the slower moving infantry; in the attack, rapidly reinforcing any temporarily shaken or wavering parts of the line; in the defence, reinforcing threatened points, a particularly important and probable duty, as has been shown in the foregoing paragraph on infantry. Warfare in the south of England or similar countries is certain to be marked by surprises, ambuscades on a large scale, and unexpected developments generally. It may be deduced, therefore, that a commander would allot the bulk of his mounted infantry to the general reserve under his own command.

Pom-Poms and Machine Guns.

These weapons could be advantageously employed in a close country. Their greatest enemy is the hostile artillery, but in this

country a very small measure of intelligence will enable pom-poms and machine guns to get right up to the most decisive ranges, hidden from both hostile guns and rifles. They will play a considerable part in local surprises, and their fire will have the most decisive local results. It might also prove advantageous for single machine guns to stalk hostile guns in action. Opportunities will no doubt be found of approaching unseen within five or six hundred yards of hostile batteries, when the sudden opening of machine gun fire could not but have a most decisive effect on the artillery *personnel*.

Horse Artillery.

Normally the wagons of horse artillery march in rear of the main body of the cavalry brigade. It is suggested, however, that in very close country there is some little danger of their failing to get into communication with their guns in the event of the latter moving some distance rapidly into action. Horse artillery's proper target is the hostile horseman, but as, in very close country, cavalry will not be able to act mounted, it is probable that the guns will not infrequently be required in the front line, and will be called upon to turn their attention to other targets. Other points that present themselves in connection with the employment of horse artillery are common to field artillery, and are dealt with under that arm.

Field Artillery.

Is the position on the line of march usually allotted to this arm suited to the tactical requirements of a close country, or should guns march further in rear? It is frequently argued that as guns are helpless on the line of march, and, in a close country, ambuscades are probable, it is desirable that they should be relegated to the rear of a column. But this argument loses much of its force when it is remembered that no force marches without an advanced guard, and the normal order of march of a column places some infantry in front of the guns. It is, however, a cogent argument for reducing the guns with an advanced guard to a minimum, and also against marching guns along different roads from those used by the infantry when the enemy is within striking distance. Artillery has now 48 rifles per battery, and these, assisted by the infantry at the head of the column, should be sufficient to cope with any small force of the enemy that may have eluded the advanced guard. On the other hand, there is nothing in recent warfare to show that the principle, enunciated by Napoleon, and confirmed in the Franco-German War, that the rapid development of a powerful artillery in the attack confers great tactical advantages—*e.g.*, the German guns at Wörth—has lost its force. But it will be admitted that artillery marching in rear of long columns of infantry whose 1st line transport could not, even if it would, clear the road, will be hours getting into action. Moreover, it would probably come up in detachments with the attendant risk of being overwhelmed in detail by a numerically inferior hostile artillery. The argument that guns marching in front of infantry cut up the roads, raise the dust, and generally enhance the difficulties and fatigues of the infantry is sound, so far as it goes, but at best it only amounts to a question of convenience, which cannot be well considered when a serious error is thereby

entailed. The deduction is, therefore, that, given an enemy within striking distance, the most suitable place for the guns is as near the head of the column as possible.

The position on the march of the ammunition columns, now forming part of artillery brigades, calls for some remark. Ammunition columns should normally march in rear of all combatant troops. There are a few objections that may be urged to this procedure; firstly, the tactical unity of the artillery brigade is destroyed; secondly, and far more important, there is a grave risk in close country that the officer commanding the ammunition column may fail to obtain communication with the officer commanding artillery brigade, and still greater probability that, even if he does obtain communication, it may be found impossible to get up the wagons owing to the congested state of the roads. "Field Artillery Training" appreciates these dangers, and careful arrangements are made to overcome them. These arrangements would probably suffice in normal country, but anyone acquainted with the terrain of the South of England cannot but feel grave misgivings as to the possibility of the wagons of an ammunition column, marching in rear of a long column of infantry, ever reaching the batteries in action. The introduction of Q.F. armament will no doubt greatly enhance the demand for ammunition in the firing line, and render more serious any failure in the supply. If ammunition columns are to march in rear of combatant troops, it is certain that the most careful staff arrangements will be required to enable them to get into touch with the artillery commanders, and to overcome the inherent objection of all arms to allow artillery wagons unaccompanied by guns to pass them on the road. The alternative of marching artillery brigades intact at the head of the column has much to be said for it from the point of view of ammunition supply, but the great length of the column of guns and wagons thus formed is prohibitive. The length of this column might be diminished by the detachment of the S.A.A. section. The existence of this S.A.A. section in artillery brigade ammunition columns is a point in itself which it is proposed to discuss later. The subject of ammunition supply in a close and difficult country is too large to be dealt with in a paper of this size, but enough has been said to show that either the batteries must have sufficient ammunition with them to render them ordinarily independent of their ammunition columns for at least 24 hours, or their ammunition columns must not be relegated too far to the rear on the line of march. The above arguments also indicate some of the advantages that may be claimed for 4-gun batteries with a Q.F. equipment, the place of the other 2 guns being taken by ammunition wagons.

The position of an ammunition column in action in this country will admit of some modification by which the difficulties of supply will be lessened. A very noticeable and frequent type of artillery position is near the summit of an undulation whose upper slopes are steep, and which has deep combes, usually with wooded sides and boggy bottoms, running perpendicular to its crest line. Such positions would admit of ammunition columns up under cover to within half a mile or less, in a direct line, from the limbers and second line wagons. This would greatly lessen the difficulty of sending up the full wagons and receiving back the empty ones.

Returning to the S.A.A. sections of ammunition columns, it appears certain that it will almost invariably be necessary to detach

them at the very commencement of, or previous to, an action to form them into divisional S.A.A. reserves. It is clearly improbable that the divisional artillery will come into action in the centre of the infantry, not to mention the possibility of its detachment for concentrated action under the C.R.A. It follows that some at least of the infantry will have to send across the rear of the whole line of battle for ammunition. The difficulty, if not impossibility, of doing this across a mile or two of country like the south of England, with all the roads more or less obstructed, need not be enlarged upon.

Turning to the action of the field artillery in the attack, the first point to consider is the nature of positions most suitable, and how far they are likely to be attainable. Without entering upon the controversy of concentration versus dispersal of guns, it will be sufficient to point out that the advantage claimed for concentration is the power it confers of directing an overwhelming artillery fire, first on the hostile batteries in succession, and, secondly, on the hostile infantry at the point selected for attack. Although the former may be feasible, it will, in most cases, be found that the enemy's infantry position is hidden from view. He will certainly endeavour to select a defensive line screened from all points where hostile guns are likely to come into action. In the type of country under consideration most of these points would be easily foreseen, and the abundance of cover would not fail to provide the screen from view required by the defence. Consequently it may be inferred that one of the principal advantages claimed for concentrated guns would be denied them. Again, the votaries of dispersed guns claim as their great advantage the power of bringing to bear convergent and enfilade fire. Now convergent fire demands good communications, enfilade fire requires unrestricted view, if they are to be effective. Both of these *desiderata* are likely to be as bad as can be in this sort of country. Consequently dispersed guns will also be denied their principal advantage. There are numerous other points to be considered in this controversy, but the generally accepted idea at present is concentration in several big batteries, not in one big battery for the attack, and dispersion for the defence. Accepting this as the *desideratum*, let us inquire how far it is suited to the terrain of the South of England. As was noticed in the prefatory paragraphs of this article, the country is undulating, with the undulations culminating in places in bare downs. Going further than this, it is quite a noticeable feature that where the undulations are not of sufficient altitude to be downs, there is, nevertheless, a very marked tendency to openness on their summits, and consequently artillery positions for considerable numbers of guns are more numerous than might be expected. It will not usually be possible to bring large bodies of artillery into action in one continuous line, but it will often be possible to occupy a series of positions close together, constituting, for all practical purposes, one line, and capable of direction by one man. But, although the positions exist, their occupation will present some little difficulty. The simultaneous advance into action of a large force of artillery on the lines laid down will seldom be possible. Guns will be obliged to move more or less slowly into covered positions close in rear of the position on which it is intended to bring them into action. When all are ready, a simultaneous forward movement of a few yards will take place. It will moreover usually be necessary for the gunners to utilise the short halt under cover, to prepare routes for the advance in line even of a

few yards for their guns. Under normal conditions artillery in the attack would occupy two if not more positions—a first medium or long range position; a second decisive range position, from which to render close support to the attacking infantry. In this type of country, however, it is only on rare occasions that guns would be able to advance rapidly, straight to their front. Any advance made would probably, of necessity, be in column of route along some tortuous lane, with the probability of finding it blocked *en route* by ambulances, S.A.A. carts, etc. The result of this will be that the great bulk of the guns will come into action at effective range, and stay there, only such small portion advancing in close support of the infantry as may be able to do so by some chance feasible route direct to their front. Although it is indisputable that this inability to advance in close support of the infantry is bad, if only on the score of the moral support lost, still, it must not be overlooked that a large battery of guns in a position that they have occupied for some hours is very favourably situated in event of the enemy delivering a counter-attack. The enemy's actual position will no doubt be carefully screened, but he cannot hope to make any large counter-attack without exposing himself to hostile artillery fire. The French experiences in 1870, notably at Wörth, demonstrate clearly the power of concentrated artillery fire, even in the days of muzzle-loaders, to bring the most spirited counter-attack to a standstill. *Apropos* of this, it is interesting to examine how far "rapid fire" from Q.F. guns is likely to be useful in the attack. The Continental system of covering areas with a hail of projectiles does not seem likely to be effective here. Firstly, the abundance of cover will deny definite targets, and, secondly, for the same reason, it will be impossible to predict with any accuracy what areas hostile infantry are likely to traverse, or to know at what moment they are making the attempt. On the other hand, should the defence counter-attack in force, they will certainly sooner or later be obliged to expose themselves, and traverse some ground of which the exact range and fuze is known to the attacking guns. Here, then, will be the opportunity, and the suitable target for the Q.F. "rapid fire." It seems probable that the type of country under consideration will demand modifications in the most recent systems of "ranging." It is suggested that the latest innovations aiming at more rapidly finding the range and fuze, would be found unworkable in very close country, and that it would be necessary to return to the old slower, but more easily observed methods. The observation of rounds fired at three seconds' interval in such a country as the southern counties could not but be a most difficult operation, especially when complicated by the fire of other batteries and all the disturbances of battle.

Sufficient stress is not laid in the books of training on the vital importance, especially in the attack, of keeping the artillery commanders accurately posted up in the infantry movements and the progress of the infantry advance. Although in a general way this is the duty of the staff, yet it is not the duty of anyone in particular, and definite arrangements to secure its performance are seldom made. It is generally left to the artillery commander to make what deductions he can by the use of his glasses. South Africa, however, on more than one occasion brought out the futility of trusting even the best of glasses to distinguish friend from foe at the ranges that will obtain in the battles of to-morrow. At all times necessary, this point of close communication and consequent co-operation between the guns and the

infantry will be doubly important in close country, where the artillery commander cannot, by his own observation, remedy omissions.

Turning now to the artillery of the defence and presupposing numerical inferiority, let us examine how far the terrain of Southern England will affect the methods and quantity of assistance rendered by field guns. The defending guns will have two main objects in view. Firstly, appreciating the difficulties attending the simultaneous opening of fire by the attack, to overwhelm the hostile guns in detail, and at the same time to avoid being drawn into an artillery duel with superior numbers. The accomplishment of this object will be facilitated by the fact that the suitable positions for the hostile guns will be more or less clearly defined. Secondly, to retain the power of bringing a heavy fire, at decisive ranges, to bear on the attacking infantry at the moment of their assault, and also of supporting with effective fire any large counter-attack that may be delivered. The methods suggested to effect these purposes in a close country are:—

1. Two or three considerable batteries, 36 guns, carefully hidden in selected and intrenched positions to deal with the hostile guns as they come into action.
2. A large proportion of the guns to be dotted in batteries or sections, in various tactical localities, in the position where they will be entirely screened from hostile guns, and where their presence will be unsuspected by the attacking infantry, until the latter are suddenly assailed by their fire at decisive range.
3. A proportion of the guns not to be unmasked until the point of the decisive attack is known. These guns then to occupy previously prepared positions, but not to open fire until they can do so with the advantages of surprise, decisive range, and immunity from hostile guns.

It is clear that these three methods would only be feasible in a close country, and also that a Q.F. equipment is necessary.

The question of field artillery escorts has always been a source of some difficulty. "Artillery Training" advocates mounted troops as escort, but the practice is to detail infantry. In a close country where artillery is less likely to move rapidly there is more justification for the infantry escort, but, on the other hand, in such country the escort, if the guns do move, becomes of vital importance. It is quite hopeless to expect infantry to keep up with the movements of field artillery. The ideal escort, especially in close country, is mounted infantry, who can safely push out to the front and flank, and at the same time can rapidly concentrate and accompany the guns if a change of position should take place. Before leaving the field guns, it may perhaps be of interest to investigate how far warfare in the South of England bears on the question of shields versus no shields. The war in South Africa, with its unrestricted view and generally stationary targets, has encouraged a great belief in indirect fire, so much so, that it has become almost the custom to look askance at gunners using direct fire. But if the country is close, targets will be indistinct and opportunities fleeting. If guns are to adequately support their infantry in the various phases of the combat, they must be prepared to rapidly change their target and to cope with moving targets. To do this, and also to get the best value out of a Q.F. equipment, the target must

be visible, which entails a certain amount of exposure of the guns. By this it is not meant that guns should return to the field-day manœuvre of past years, of a brilliant advance in the open, terminated by action fully exposed to every hostile gun. But it is probable that they will be obliged to expose themselves sufficiently for the enemy to locate them. Directly they are so located the hostile infantry commander, who is suffering from their fire, will endeavour to stalk them with rifles and machine guns, and there is every reason to believe that he would often succeed, in close country, in getting within a few hundred yards unobserved. Even if not deliberately stalked, guns operating in this country will invariably be exposed sooner or later to close infantry fire. When this occurs there can only be one result, especially if a machine gun is employed—the destruction of the artillery *personnel* attacked. The extra weight and visibility of shields are drawbacks, but they are more than compensated for by the advantage to Q.F. guns of direct over indirect fire, especially when the former can be resorted to with comparative impunity. The deduction is, therefore, that in a close country shields are a *sine quâ non*, and, that, in any case, if the best value is to be obtained from a Q.F. equipment, shields are essential.

Heavy Artillery.

Close country and restricted view will often prevent heavy guns from availing themselves of their long range. Ill-defined targets, indifferent facilities for observation, and the lack of suitable positions outside field gun range will do much to diminish the useful fire-effect of these weapons. *Apropos* of heavy guns, it has recently been stated by an officer, not an artilleryman, who is an advocate of heavy metal in the field, that two heavy guns are of more value than a field battery at all times. But this statement does not appear to sufficiently consider:—

1. The effect of Q.F. shrapnel fire on a 4·7 trying to come into action.
2. The difference in rate of fire between two 4·7's and six Q.F. field guns.
3. The unavoidable limitations to the quantity of ammunition that can accompany heavy guns.

If these points be considered, it seems little short of suicidal to ask long-range guns to compete with treble their number of field guns at the latter's own range. The war in South Africa has led to a more or less general belief that there will be no great difficulty experienced by heavy guns accompanying marching columns. Although this belief received some confirmation from the fact that heavy artillery did successfully accompany the Ist Army Corps in the manœuvres of 1903, yet there seems good reason to suggest that the constantly recurring and frequently heavy gradients on even the best roads in the South of England could not fail to seriously affect the mobility of heavy guns in operations that were at all protracted. Again, in the matter of getting into action, an English ploughed field after rain is very different from the African kopje. It is suggested that two courses might be taken to get over this difficulty: firstly, owing to the abundance of fuel and water, mechanical transport might be employed; secondly, advantage might

be taken of the numerous lines of rail to mount a proportion of the heavy guns of an army corps on railway trucks, from which they could be fired, as was done in South Africa.

Field Howitzers.

Howitzers are entirely dependent for fire-effect on the facilities for observation in the vicinity of the position they are intended to occupy. In a close and undulating country these difficulties of observation will be at a maximum. It is suggested for consideration that the howitzer is a special weapon intended for special purposes, and that consequently it is preferable not to detail it to take part in the general artillery attack of an enemy's position, but to hold it in reserve for use when the particular target for which it is intended appears. Such a target would probably be found in a house, or hamlet, in a wood held and fortified by the enemy, but quite unassailable by field gun fire. During recent staff rides and manœuvres the author has frequently noticed tactical localities in defensive positions, which could only have been attacked by howitzers, and the existence of which would only have been discovered by the attacking infantry during the later stages of the fight. Anyone observing the employment of the howitzer brigade both in the Ist Army Corps and the Army Manœuvres could not have failed to feel that their fire-effect was probably infinitesimal, and that they would therefore have been found more useful employed in single batteries dislodging the enemy from his prepared tactical localities in different parts of the field.

Royal Engineers.

It is only the experience of actual warfare that properly brings home the great value and importance of the field company and troop R.E., and should the theatre of war ever be Southern England there can be little doubt that their value would, if possible, be greater than ever. The hasty fortification of tactical localities, the cutting and preparation of communications, the rapid erection of temporary bridges, the demolition of existing bridges, the creation and removal of obstacles, water supply difficulties and arrangements are some of the duties which would require the assistance of the field company. It needs no argument, therefore, to show that a section of a field company with an advanced guard is essential, and that the remainder of the company should march very near the head of the main body; in fact, it would often be preferable for the whole of the field company to accompany the advanced guard.

Owing to obstructions to view and obstacles to moving straight across country, the general employment of the field telegraph will be very necessary. It is open to consideration whether the attachment of a telegraph detachment to each division would not be desirable under these circumstances. Wireless telegraphy has not at present reached a sufficient state of perfection to be of any military utility, but when it is so perfected, it seems probable that the presence of a telegraph detachment with each division will be essential. In the South of England there are few rivers that could not be dealt with by the field company, assisted by the supplies of material available almost anywhere. Such larger rivers as there are are well known, and, unless one of these lay directly across the march of the day, the pontoon troop might well be relegated to the rear of the column.

Balloons are especially useful for reconnaissance and for transmission of signals, both of which services would be particularly valuable in close country. It is suggested, further, that a balloon section of one captive balloon attached to the corps artillery would do much to mitigate the difficulties of observation that would so handicap the heavy guns and howitzers in this type of country.

Combined Action.

Under this head it is now proposed to investigate what points in "Combined Training" are likely to be emphasised when a country similar to the South of England is the theatre of war. The stopping power and power of deception conferred by modern arms in this type of country on small bodies render it essential that the most vigorous steps be taken to obtain accurate information. The reconnaissance in force has always been and is still deprecated, principally because of the danger incurred of bringing on a premature and undesired engagement in order to extricate the force. But, in very close country, would not that objection lose some of its weight? It is generally admitted that a reconnaissance in force, if made at all, should be made late in the day, so that withdrawal can be effected under cover of darkness. Again, it is undeniable that darkness in itself is of no assistance to any manœuvre. It is therefore the cover afforded by darkness that enables that manœuvre to be considered, and, in a country that provides abundant cover, it is open to question whether the darkness might not be dispensed with—that is, that, in this country, a reconnaissance in force will be a more justifiable method of obtaining information than it would be under normal conditions.

The battle of the future will probably take the form of a succession of struggles for a series of tactical localities. As is pointed out in the books of training, their duration will certainly exceed one day, and consequently it will be necessary to arrange to replace the inevitable, heavy losses, and usually to supply fresh troops to carry on the advance. These considerations point to large reserves kept in hand, but, if this is done, there is no small danger of frittering away strength by sending forward a succession of weak attacks instead of one strong one. History is fruitful of instances of this mistake in war, and perhaps there is no better example than Fremont's attack on Jackson's containing force at Cross Keys. Again, if battles are going to extend over several consecutive days, it will frequently be necessary to send up supplies to the firing line at night. Owing to the exhaustion of the men forming that firing-line, it will generally be impossible to get anything up by hand; in fact, it is more probable that the men will prefer to sleep hungry where they lie. It is suggested that officers commanding units will be well advised to arrange for supplies to be sent up on all available pack animals. For instance, as soon as darkness brings the action to a standstill, empty ammunition mules, unless immediately required to fill up with ammunition, might be utilised to bring up food. However feasible that may or may not be, it seems clear that unless commanding officers display some initiative and forethought in this matter, it is exceedingly probable that the men in the fighting line will get nothing to eat, and consequently that their fighting efficiency the next day will be very seriously diminished.

The large extent of modern battle-fields, the difficulties of control and communication, and limited facilities for personal observation inevitable in close country, render it imperative that a commander should have eyes in many parts of the field at once. Doubtless subordinate commanders would always inform the G.O.C. of the progress and developments of the fight in their vicinity, but it is the experience of past wars that every man has a tendency to exaggerate the state of affairs in which he is personally concerned. This is the more noticeable when things are not going too well. There are numerous instances in history of the most urgent appeals for reinforcements being quite correctly refused by the chief commander. It will consequently be of great assistance to a commander to have staff officers in various parts of the field who are acquainted with the higher situation, and who, without interfering in any way with the local commander, will observe and rapidly communicate the true state of affairs in their vicinity. Some further arrangements for the equally rapid communication of the progress of the infantry fight to the officer commanding the supporting artillery is also very desirable.

If an advanced guard is to carry out in a close country the duties laid down for it, it must be stronger than would suffice under normal conditions. In such country deception on the part of the defence is so easy, and the holding power of a few rifles so great, that a weak advanced guard would be constantly stopped, once contact with hostile advanced troops was obtained. If an advanced guard is strong, its commander will feel justified in taking advantages of the facilities afforded by this type of country to estimate his force, and in invariably attacking vigorously any force checking his advance. He will be justified because:—

1. Time gained by the enemy by the delaying action of his advanced troops is probably invaluable to him, and should be denied him at all costs.
2. Should he find that he has committed his force to an action with superior numbers, he will, as has been previously pointed out, in this country be able to withdraw without involving his whole main body in an unpremeditated action.

A close country in daylight confines the march of all but the smallest bodies of troops to the roads. At night this is even more the case. It follows, therefore, that if roads and passages over obstacles are observed and held, an effective outpost line has been established. The guarding of clearly defined points, such as these, demands fewer men than a continuous line in open country. The deduction is that in a close country at night a given unit can guard a larger front than in more open country. Again, in a country whose cover from view is abundant, the outpost line can with safety be drawn in nearer the camp. This will diminish the outpost perimeter. For these reasons it is suggested that the proportion of a force necessary for outpost duty can be safely reduced in close country. As a corollary to this, it may be regarded as in the highest degree improbable that anything in the nature of a night attack would ever be attempted. On the other hand, the good and easily followed roads would render a night march out of striking distance of the enemy, or under cover of advanced troops, quite practicable.

Conclusion.

It has been the object of this paper to bring to the notice of officers of all branches points that it seems probable would certainly present themselves for their consideration, should they ever be engaged in operations in country of the type selected. Most of these points have been brought to the notice of the writer during staff rides and manœuvres in the southern counties of England by incidents which have actually occurred. Others have been deduced as likely to appear when the principles of modern warfare, as now generally accepted and laid down in the books of training, are put into practice. To summarise, it has been shown that, as might be expected, the long range arm—artillery—is most affected by obstructions to view. An attempt has been made to show that, though undoubtedly handicapped, still, with some modifications in its fire tactics, artillery will be able to render as effective and valuable assistance to the other arms as it would do under normal conditions. The difficulties of ammunition supply, so well appreciated since the experiences of actual warfare in South Africa, have only been sufficiently touched on to indicate in what special directions these difficulties would probably occur under the particular circumstances discussed. The probable sphere of action of mounted troops has been indicated, and the difficulties that will beset any attempt at reconnaissance or the obtaining of information have been shown. Attention has been drawn to the special features of the hedge-to-hedge infantry combat. It has been brought out that the duration of the battle of the future with its succession of sanguinary struggles for tactical localities will cause very great physical exhaustion to the troops engaged, necessitating a constant supply of fresh troops, and also particular arrangements with regard to the supply of ammunition and food. The importance of some means of rapid communication between the infantry and artillery commanders, by which the close co-operation of these two arms may be assured, is touched upon. Some slight modifications in the strength and tactics of advanced guards and outposts are suggested. The great value and importance of the R.E. services, not usually fully appreciated by those without experience of war, has been brought to notice. When all these different considerations are taken as a whole, it may reasonably be inferred that decisive tactical success, such as an Austerlitz, will be very difficult of attainment in a close and intersected country like that of the South of England.

THE LESSONS OF THE BOER WAR AND THE BATTLE-WORKING OF THE THREE ARMS.

A Lecture delivered before the Berlin Military Society, on 30th March, 1904, by Major BALCK, of the Great General Staff.

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1.—General Conditions and Lessons for Infantry Combat.

IF we do not enter into the question of guerilla war, only the battles up to the capture of Pretoria on the 5th June, 1900, come really under purview for tactical consideration.[1]

The distinguishing mark of the Boer method of fighting is one of passive defence pure and simple, which may well avoid a defeat, and stave off any decisive results from day to day, but can never achieve victory. Only the leader who has attacked and destroyed the enemy can call himself victor. The Boers failed to understand that a *counter attack* must also follow a *fire-defence*. In December, 1899, the English attacks on Magersfontein and Colenso were repulsed; but the Boers allowed the English abundance of time to bring up reinforcements, enabling them, five weeks later, to repeat their attack on the Upper Tugela, and, after nine weeks, at Paardeberg. As the Boers only wish to keep the enemy at a distance, and drive him back by their rifle fire, they dispense with Reserves. It is astonishing with what small forces such a defence is possible. As, with but few exceptions,[2] the front and flank

[1] The Boers laid particular stress on this question of guerilla war, when they protested against Lord Roberts's Manifesto of the 13th September, 1900, directed against their determination to carry on what was practically a war of this nature. "The truth is," writes State Procurator J. C. Smits, in the *Nieuwe Rotterdamsche Courant*, 23rd June, 1901, "that we have begun a new method of carrying on the war, which the enemy is stigmatising by the old perverted name of guerilla. Having carried on the first half of the war in the old methods, we are now convinced that the English superiority in force is too great for us, and we have therefore struck out a new course, in which strategy, mobility, and the distribution of small fighting bodies over a wide extent of country are of much greater importance than a battle proper."

[2] "Kriegsgeschictliche Einzelschriften," No. 32, p. 34; at Elandslaagte 21st October, 1899; Driefontein, 10th March, 1900; also No. 33, p. 36 .

attacks of the English were not carried out simultaneously, the Boers were able, thanks to their mobility, to withdraw men from the less threatened positions and use them at other points. Everyone, however, did not fight in the firing line. Against the wish of the leaders, faint-hearted men remained behind under safe cover to await the result or to recover from the effects of the fatigues of fighting. Dr. Schiel[1] thus describes what he saw while a fierce fight was raging not far off upon Spion Kop on the 24th January, 1900, and every rifle was required:—

"I arrived, after about an hour's march, at the foot of Spion Kop. . . . . There I came upon a tolerably large number of Boers, who were making coffee under the protection of some over-hanging rocks; others joined them there, coming from the hill; others, again, went off to take part anew in the fighting, after having rested and refreshed themselves. . . . . Everything was done in order and quietly; there was no attempt to drive men into action; but whoever wanted to join the firing line did so, and whoever wished to keep away altogether could do so with the greatest ease."

In an unpublished account a former German officer, another companion in arms of his, made the same statement. Such casual fighters are, however, no tactical Reserves. A true offensive was foreign to the Boers; their method of attack was to creep forward from cover to cover in order better to be able to shoot down their opponents. To boldly charge the enemy they at first ridiculed as mere stupidity on the part of the foreigners.

The defence positions consisted of long connected groups of deep rifle pits,[2] which, as inconspicuous as possible, were mostly placed where the enemy's eye would least expect them, special care being taken that nothing showed against the sky-line. In order to prevent the clouds of sand caused by the explosion of the guns, the ground in front of the guns was covered with the hides of freshly slaughtered animals. The grass was often burnt in front, in order that the khaki-clad English should show up in sharp contrast to the black ground beneath them.

The Boer is an adept at deceiving his enemy. Thus sham positions were made in which dummies, to serve as targets, were set up; guns using black powder were fired that attention might be drawn from the real positions (Magersfontein), and bursting charges exploded to deceive the enemy's gunners in observing the effect of their shots.

It is ingrained in the Boer nature to take advantage to the fullest extent of the carrying power of his rifle, even to over 2,000 yards, so that it was only in isolated cases that the leader could succeed in making the men reserve their fire until close range. But when this occurred the effect was very marked. There can be no question of a controlled long-range fire. Every man firing adjusts his own sights independently, and alters them according to his own observation. As the Boer shot

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[1] "Mit den Deutschen im Burenkriege."

[2] Boulders proved good cover only for thin firing lines; with the men in closer formation the opinion was strongly held that the splinters from the rocks increased the effect of the bullets and endangered the people near.

with a fine sight, he accepted the metre-graduation of the Mauser rifle without anything further than the paces by which he estimated his distance, and opened fire with shots at short ranges, which were easy to mark, and allowed the enemy to advance within the zone of fire. Worthy of notice was how, in a fire-action, with an enemy lying down, they watched for the opportunity if a man raised himself. Immediately bullets began to fall, and even if these did not hit, they raised a feeling of insecurity, often nipping in the bud any attempt to advance. One thing, however, was wanting in the Boers, that was the desire to resolutely await the assault, in order to engage in hand-to-hand fighting.

The English infantry was compelled in almost all actions to advance against the enemy over a plain completely destitute of cover, and whose position was difficult to locate. An army cannot disappear as the Boer detachments were able to do. The English scouting might certainly have afforded better results; no attempt was made to tear away the veil which the Boers had spread in a great measure over the whole country. Finally, the English cavalry failed to continue scouting on foot when they could go no farther on horseback. In whatever direction the slow-moving infantry was led, the more mobile Boers were always able to oppose a new front to the enemy. The case was, however, otherwise when their increasing strength enabled the English, with their columns extending over a wide front, to simultaneously seize several positions within the veil, and to force the Boers to occupy a definite stretch of country, thus rendering them immobile. It would be wrong to endorse these tactics, which were called into being under quite exceptional circumstances, without a wider survey of the theatre of war. The course of the attacks in the first battles was as follows:—

One or two days before the actual attack the artillery opened on the position with shrapnel and lyddite shells from flat-trajectory guns. This fire had but little effect, as the opportunity was neglected of simultaneously bringing forward a stronger force of infantry, in order to hold the Boers to their position. The hope, too, of inducing the Boers to return the fire, in order to gain footholds for the capture of their positions, was not realised.

The attack was hurriedly carried out — after the fashion of manœuvres. In thin skirmishing lines, the reserve detachments likewise in loose order, with, as a rule, but a slight loss, a distance of about 800 yards from the enemy was reached. The volley firing laid down by the Regulations could not further be carried out, as, with the thin skirmishing lines, the officer could only exercise control over the men near him.

The uselessness of this method of firing and the increasing effectiveness of the enemy's fire paralysed all energy, and quickly engendered that fatalistic inactivity and lack of mobility, which set a limit to the attack earlier than was justified by the extent of the losses. "The void of the battle-field" has become the significant expression for a new phenomenon, opposed to which the English fighting training proved ineffectual. The invisibility works directly upon the *moral* of the man, upon the true sources of his energy and his mettle. The soldier who cannot see his enemy, ends by seeing

him everywhere. From this impression to a feeling of insecurity and then to one of fear is only a step. This feeling of unsubstantiality an English officer characterises as the most painful in the conditions of the modern offensive attack. "It originated in smokeless powder, which was used in South Africa for the first time, and through the artfulness of the Boers in making themselves invisible to their enemies. When attacking, a man has the feeling of advancing against an invisible fate, against which he possesses no weapon. Should a man wish to open fire at longer range, he shoots more or less at haphazard. The defender, however, fires as soon as a man rises and advances, without his enemy being able to see him."

The troops of the second line approached with the expectation, in the spirit of the Regulations, of carrying all before them by a bayonet charge, under the firm conviction that the Boers would not stand against an attack with the *arme blanche*. The trust in the *arme blanche* was thoroughly justified, but it must only be based on a successful issue of fire action. Before, however, the fire superiority was established, the advance by rushes began. The detachments, meeting a heavy fire, threw themselves down and returned it, often without knowing where to aim, except in the general direction, where the enemy was supposed to be. As a rule the attack now came to a standstill. When, however, it came to storming isolated positions, only a portion of the fighting line advanced, against which the defenders could direct their fire all the more effectively, as the guns had ceased firing.

Compared with former battles, the small proportion of losses to the large number of prisoners is astonishing. Although it is true that in South Africa isolated detachments often in a short time suffered heavy losses, yet, considered as a whole, the losses were but small. They amounted in the battles to not more than 14 per cent., although, naturally, isolated, especially the smaller detachments, suffered considerably more. In their colonial wars, English troops have achieved victory by great physical exertions, still with but small actual loss of life. Such battles have the disadvantage of misleading the Army in its views as to the losses which a seriously pressed home attack demands to-day. The heavy losses which English troops suffered in the Peninsula, at Waterloo, and in the Crimea have been forgotten.

Public opinion in England, which is all-powerful, influenced by sensation-hunting ignorant correspondents, went even so far astray as to consider small losses the sign of good, tactical dispositions; and leaders, who have inscribed their names in history in iron characters, must give way to generals who subscribe to the precept that discretion is the better part of valour. It is conceivable that the English commanders were more or less influenced by this morbid flood, which hindered them from bringing the war to an end by summary, powerful blows. How pertinent and classical for all time are Clausewitz's words:—"Let us not hear of generals who conquer without bloodshed. "If a bloody slaughter is a horrible sight, then that is a ground for "paying more respect to war, but not for making the sword we wear "blunter and blunter by degrees, until someone steps in with one "that is sharp and lops off the arm from the body." That such long drawn out wars without bloody annihilating battles tend in the end to

produce the heaviest losses, is directly proved by the war in South Africa.[1]

The more sternly and remorselessly a war is waged, the less are the opponents able to come to an understanding with each other; the fewer are consequently wont to be the number of prisoners. At Isandlwana (1879) an English battalion (the 24th) succumbed, with the exception of a few who escaped, to the spears of the Zulus; at Maiwand (1880), also, scarcely a man surrendered to the Afghans, as quarter could not be depended upon. Quite otherwise was it in South Africa: Boer and Briton understood the same language; the intention to kill their opponents was seldom displayed by the Boers; equipments, horses, and arms were taken from their prisoners, who were then generally let go; only a portion were interned at Pretoria, and these were well treated. We may draw a comparison here with the insults to which our prisoners in France were often treated.[2]

Even in the very early days of the campaign came the laying down of arms by strong detachments, which apparently was not punished with the severity which it merited. We almost get the impression that surrender was looked upon by the men as a means for getting themselves out of a difficult situation.

In country devoid of cover, commanded for a considerable distance by the enemy's fire, to break through was of course difficult; a retreat doubtless attended with great losses. It was therefore easy for the mounted Boers to waylay isolated detachments; we must also further bear in mind that the war was carried on in the hottest time of year in a country poorly supplied with water, and that the men became exhausted sooner than would have been the case under other conditions. Thus there was an excuse, for example, for the men who, exhausted after their night march, capitulated at Stormberg; not so, however, to take another example, for the detachment under Colonel Carleton, which capitulated at Nicholson's Nek after a feeble defence. Here it may certainly be admitted that individual

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[1] The following statistics of the losses up to 8th November, 1900, are given in Conan Doyle's "Great Boer War":—

	Officers.	Men.
Fell in action	283	2,683
Wounded	1,064	12,868
Died from wounds	85	179
Missing and prisoners	283	7,330
Of these were exchanged or escaped	240	6,299
Died	3	86
Died of sickness	149	5,472
Died of accidents	3	101
Invalided	1,219	27,937

There were 368 officers and 3,462 men who met their death through the enemy's lead, as against 152 officers and 5,573 men who succumbed to sickness or accidents. The total losses of the Army, including prisoners, amounted to 1,782 officers and 30,002 men, out of a force of 5,880 officers and 151,546 men.

[2] Lieutenants Puttmann and Brüggemann, of the 3rd Brandenburg Regiment, in their history of the regiment, give details of the unworthy treatment to which German prisoners were subjected in France.

Englishmen, who had already surrendered, stood mixed up with the Boers, so that the leader did not really know how he ought to act under the circumstances, and this hesitation was decisive of his fate. It must be imperatively required in the future that troops surrounded in open country make a serious attempt to cut their way through before there is any thought of laying down their arms. As opposed to this conception, the English Court of Inquiry on the 226 cases of surrender which had taken place up to 1st June, 1900, admitted justification in all but three, where only individuals had allowed themselves to be taken prisoners.

The want of success of the English attacks was to be traced to defective arms and an inadequate training in shooting under battle conditions,[1] and more especially to the unsatisfactory tactical training of the superior officers, whose lack of initiative and fear of taking responsibility became a by-word, while the younger officers did very much better. The troops themselves were brave enough, but not prepared for such duties as fell upon them in South Africa.

Major Balck then quotes from Lord Roberts's evidence before the War Commission as to the want of individuality and resourcefulness on the part of the English soldier at the beginning of the war, and his defects as a marksman as compared with the Boers, and his want of knowledge of how to use ground. (Report of War Commission, p. 440.)

All reports concur in the view that the sectional and company commanders showed in almost every case energy, self-reliance, and determination, that their tactical training was, however, insufficient, and that the senior officers were not anxious to take responsibility upon themselves. It may be because with increasing years these latter had become more irresolute, or that they had had no practice in handling strong detachments. But the whole system of peace training was unfavourable for producing self-reliant leaders; everything was laid down, every attempt at independent action repressed. Thus General Colvile declares: "It is much better for a young officer to make mistakes and learn what the consequences will be, than that he should

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[1] In a competitive shooting match, picked shots at Shanhaikwan, on 18th and 19th August, 1902, made the following scores at 200 yards against the German ring target with 10 shots (the highest possible score being 120):—The English detachment made 84·6; the German, 79·2; the French, 73·2; the Japanese, 70·9; the Russian, 66·9; and the Italian, 46·8.

"A requirement which the English could not fulfil," remarked a Boer, "we, on the other hand, could always comply with, viz.: judging distance and independent choice of sighting by men individually. In this respect the English, as far as we could ascertain, were not only quite unskilled, but, what is worse, they had been trained on an utterly erroneous system. Perhaps that this was so was of more importance than is supposed. Of 35 men whom we took prisoners, after they had fired at us up to 350 paces, not a single one had got his sight correct. Most of them had kept their sights fixed at 800 and 850 yards, because no order to change them had been given. Such a thing was not possible with the Boers. Certainly if a whole line of Boers had never all had their sights right, on the other hand, they had never all had them wrong. Every man could adjust his own sight, he could make a mistake; but he made the attempt to observe the change of distances."

be trained to avoid faults, as in that case he will then become a puppet, which can only move when his superior pulls the string." The fear of once blundering in the choice of expedients was extraordinary; it led to inaction, and was the cause of many favourable opportunities being allowed to slip away by those in command.

The leaders must be blamed for not understanding how to regulate the co-operation of all arms, in order to carry through a united attack. Above all, they hesitated, when the issue hung in the balance, to achieve victory for the English colours by putting into the fighting line the whole strength of their reserves. At Colenso (15th December, 1899), out of 15,600 men opposed to 5,000 Boers, only some 4,800 were actually engaged, who suffered a loss of 15 per cent. On the 24th January, 1900, the day of Spion Kop, there were 20,000 available for the attack, of whom, from 3 a.m. to 9.30 p.m., only 2,600 took part in the action; about 11 o'clock these were reinforced by another 1,600, and again at 5 by 1,500 more. What the strength of the Boers was it is impossible to state accurately; at all events there were only some 3,000 men at this spot. The English were, however, beaten, although there were 14,000 men who never came under fire at all. Here the leadership failed from lack of determination.

Various pleas have been urged in excuse for this: the numerical inferiority of the English forces at the beginning; the disproportion of the troops to the great extent of the theatre of war; the difficulty of bringing up reinforcements from the distant mother country; the eventual effect of heavy losses upon the recruiting for an Army based on voluntary service; and even the influence which a defeat might have had upon the attitude of the European Powers. Still, all these pleas could not exonerate the leader on the battle-field. For this neglect the English Drill Regulations are primarily responsible, which lay down hard and fast the necessity for keeping back the reserves in a picked position. Clearly these Regulations, which were no longer suited to the times, were a heavy drag on the English Army. The Infantry Regulations, while only attaching small importance to the fire action, laid great stress upon the shock action of a strong second line with the bayonet, and over-rated the importance of isolated attacks upon the course of the whole battle. Unfavourable conditions of training in the Mother Country militated against the development of a modern system of tactics. Whilst the importance of enveloping movements was certainly appreciated, frontal attacks were, often, even regarded as a sign of unsatisfactory tactical knowledge. But it was not recognised that enveloping movements required unconditionally the firm holding of the front, if they are to be effective and the enemy not to be left free to withdraw at will as soon as his flank is sensibly threatened. But the English forces holding the front were handled in such a way that their feeble and hesitating movements left no doubt as to the real intentions of the attackers. It was only an empty threat with insufficient means. The knowledge also that infantry and artillery must work together in order to establish fire superiority was not general in the Army. Artillery preparation in advance and infantry attack were two things sharply separated from each other.

Sounder views had developed before the outbreak of the war in South Africa in the various actions on the North-West Frontier of India; but the troops who had taken part in these actions were shut up in Ladysmith after the early successes.

Only painfully and slowly could the troops trained at home under quite other conditions, and strengthened by Reservists who had passed through a yet earlier training, accustom themselves to the new conditions.

All troops coming fresh into the field have to divest themselves of a mass of habits unconsciously acquired on the manœuvre ground during peace, which have mostly led to an insufficient appreciation of the effect of weapons. This was evident with the Austrians in 1866, during the battles in August, 1870, and in the Russian abortive attempts to storm at Plevna. While the rapid course of the campaign in Bohemia hindered our then opponents from changing their tactics, we see in the Franco-German war a difference in the method of the earlier and later methods of attack, which was plainly noticeable by even the superficial observer. We need only compare, for example, the attack by the King's Grenadiers on Schloss Geisberg and that of the Grenadier Regiment No. 11 on the Gorge-Rezonville road with the attacks by the Baden Life Grenadier Regiments on the railway cutting at Nuit and the attack of the Guard on Le Bourget in order to appreciate the extent of the advance made on our tactics at that time.

In every war the impression of the effect of the enemy's fire upon soldiers only trained under peace conditions will be so overwhelming—an impression which no peace training can convey—that all, like the Austrians in the first battles in 1866, ourselves in the Franco-German was, the Russians in the Balkan Peninsula, will be astonished at what seems to them an unprecedentedly hot fire. It was the same in South Africa. But the history of war shows that, even up to the present day, good troops fully and completely get over this impression. The leaders of all grades must only be prepared in advance to find the remedy immediately on the spot. This, however, can never lie in the defensive, but only in the attack. Major Kunz is right when he recommends that the lessons learnt by any body of troops at the beginning of the war should be made known as quickly as possible for the common good of the whole Army. Only in this way can mistakes be avoided, such as occurred on the 18th August, 1870, when a battalion (III. 86) attempted to make their way through the effective fire zone of the enemy in double column. Taking a comprehensive view, our Regulations of 1889 for that reason lay down: "The normal formation must be given up without hesitation, where the vicissitudes of the fighting require it." In this sentence the capability of adapting our instructions to modern conditions reaches a climax. Attempts were even made in England to justify[1] the new conditions, whilst still under the influence of the first failures at the Irish manœuvres of 1898, acting upon the principles enunciated by Lord Roberts as to the unassailability of the front.

Two fundamentally different tactical methods arose in the level plains of the Free State and in the mountainous country of Natal. In one case, to embrace in the struggle, an extension of front, ever

[1] See also Lord Roberts's Order of the Day, 26th January, 1900:—"Against such an enemy, every attempt to capture a position by a frontal attack will certainly fail. The only chance of success lies in the possibility of turning one or both flanks, or, which will mostly be equally effective, of threatening the enemy's line of retreat."

increasing, from fight to fight, by complete abandonment of any deep formation, before the enemy had even opened fire; in the other, a smaller breadth of front, with the deepest formation, without giving this up in the course of the battle. In the west the attacks failed because the supports, which should continually press forward to strengthen the firing line were wanting; in the east, because the weak force at the beginning was never strengthened, nor was the fire strength of the enemy ever opposed on equal terms. The caution in the Infantry Drill Regulations against the use of insufficient forces out of misplaced economy in the carrying out of a battle plan, is not given without cause after our campaign experiences. "One would constantly fight with inferior against superior numbers, and voluntarily forego the advantage that such superiority would give. An unsuccessful undertaking, however, not only causes useless losses, but damages the *moral* of the troops." The English leadership in battle was wrecked because the extension of front and a deep formation could not be reconciled with each other.

Lord Roberts's operations at Paardeberg and Bloemfontein determined the whole later course of the English tactics pursued. He had to overthrow the enemy while himself avoiding any failure; new defeats would have damaged the prestige of England, and might even have brought about the interference of some of the European Powers. How much this was feared in England was proved by the extensive measures taken by the Navy for the protection of the transports. Thus from the outset of his taking over the command his actions showed the impress of the cautious leader. There was certain to be a difficulty in maintaining a steady flow of reinforcements to make up for losses. So he determined to avoid frontal attacks and to manœuvre the enemy out of his positions, not, however, with the view of compelling him to fight in the open country, but only to obtain possession of the country held by the Boers. That was the distinguishing mark of the operations: the winning of positions, not the destruction of the enemy!

By a rapid flank march Lord Roberts threatened the communication of the Boers at Magersfontein; by a night march they attempted to escape; but, brought up in a very clever manner by the cavalry on the 17th February, 1900, they on the next day repulsed an attack made upon them during the absence of Lord Roberts. Lord Roberts stopped the further carrying out of the attack, and after being surrounded and bombarded for ten days the Boers were compelled to lay down their arms. The same thing happened in the fighting at Poplar Grove on the 6th March. The enemy was held but no attack was made, in the certain expectation that he would evacuate his position during the night. It is true he did so, but only to make another stand a few miles further away.

The advance was arranged from the outset with the avowed intention of surrounding the enemy. The troops advanced with the dispositions for battle fully developed. In the advance on Diamond Hill, 11th June, 1900, Lord Roberts's force, 40,000 strong, moved forward with a broad front of about 30 miles, with an interval of between 20 and 30 paces between the skirmishers. Only against a broken enemy, who it is known will not advance to the attack, is it possible to take liberties of that kind. The idea of destroying the enemy remained quite in the background.

But what may thus have been saved in bloodshed on the day of battle was more than made up for by the sacrifice entailed through the prolongation of the war. Timidity in the face of the enemy was most apparent in Buller's actions on the Tugela. Battles which opened favourably were stopped short, partial successes not taken advantage of, only because the further attack would have become a frontal one. Nothing could be more fatal than to allow troops to believe that a frontal attack is impracticable. On the contrary, troops must learn that in great battles almost all attacks will be frontal. It must naturally be assumed that as in any other attack, fire superiority has first been established. If other methods do not suffice, there remains only what is recommended by our Drill Regulations, viz., to approach the enemy under cover of the darkness, and then at daybreak reopen fire at closer ranges. This was also several times attempted in South Africa. The English Army had had in peace a good training in carrying out night attacks. Bearing in mind the storming of the Egyptian lines at Tel-el-kebir (1882) in the dusk of the morning, and the successful march to storm the Khalifa's position on the Atbara (8th April, 1898), much might well be expected from night actions. The experiences gained in 1882 were, however, forgotten, and less weight was attached to the preparations and to the acquiring all necessary information indispensable for success. Thus it came about that at Stormberg and Magersfontein the troops came on the enemy too late, and instead of taking him by surprise, were themselves surprised in close order by their opponents' fire, which wrought great havoc in their ranks. So reliance on this method of fighting died away, and the dusk was not taken advantage of, viz.: after an indecisive action, when, as we now can see, a night attack would have certainly ensured victory.

It was only a small step from reluctance to making a frontal attack to the belief that it may generally be impracticable. General Baden-Powell lays down the close connection of the *operative offensive* with the *tactical defensive* as a fundamental principle.[1] But only under particularly favourable circumstances does he consider that a frontal attack can be carried out. But the South African war shows plainly that whoever wishes to obtain a decisive result must press the attack home in spite of all difficulties. Only the attacker can use to good effect the shortcomings and blunders of the enemy. Whoever plans in advance merely the warding off of attack and a system of defence has already recognised the superiority of the enemy before the decisive blow is struck.

If weakly held positions could not be taken by numerically superior forces, it must be attributed to the faults committed by the English. This disparity between attacker and defender was apparent both in earlier wars, and to a greater extent in South Africa; the more inadequate the co-operation of the artillery, the less protection the nature of the country offers, the more difficult will envelopment become. But a skilful and energetic leadership has even in South Africa been victorious without a great superiority.

Without doubt the attack has become more difficult and more costly for infantry. The troops can only respond to the demand made

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[1] "War in Practice." By Major-General Baden-Powell, Inspector-General of Cavalry.

upon them if they find a support in the inflexible will of the leader who is determined to win in spite of all difficulties.

All half measures, then, are fatal. Our attacks will be bloody, but they will not exact greater sacrifices from us than Frederick the Great demanded from his infantry in all his serious battles. Because the expectation of incurring heavy loss restrained a leader from attacking, because, owing to the dislike of the Boers to hand-to-hand fighting, it was nearly always possible to manœuvre them out of their positions; because an attack already begun was not pushed home, it need not be inferred that a frontal attack is generally impracticable. The South African war only confirms the lessons of earlier wars:—

1. That the attacker, generally speaking, should have the superiority, the great advantage of which shows itself in the power to envelope.
2. That every well-prepared attack, which is founded upon the principle of fire superiority, must succeed. (Elandslaagte, Driefontein.)
3. That the supposed dictum as to the impracticability of frontal attacks is one that cannot be sustained.
4. That the troops must, under cover of the darkness, win what remained unattained during the day. (Modder River, Spion Kop, Paardeberg.)

"What form now does the infantry attack take, after the previous lessons have been turned to account; what can we learn therefrom for the advance over level country, if we have nothing to suffer from the enemy's artillery?"

The English infantry was surprised by the enemy's fire at Magersfontein and Colenso in close formation, at Belmont and the Modder River in battle formation. In order to avoid similar experience, a new fighting formation at ample distance from the enemy—about eight miles at Poplar Grove, for example—was adopted, which permitted only of movement straight forward; an advance in such a formation was only possible where the veldt offered no obstacles and the important question was to hold the enemy. The brigades formed with their four battalions a sort of open double column, with an interval of between three and four hundred yards between the battalions. The battalions opened their columns in such a way, that their eight companies, each in a thin line, with at first two paces interval between the men, which was finally increased to twenty, followed with an interval of from a hundred to one hundred and twenty paces.

The advantages of the deep formation, and of having the troops well in hand, so that they could also be used for other purposes than a purely frontal one, disappeared. As the brigades advanced in complete fighting formation, the cursory information obtained by the cavalry tumbling against the enemy's positions sufficed. But such a method must form the exception. For serious attack such scouting would not, however, suffice. Out-pickets may be able to prevent approach, while foot patrols, turning the slight cover of the ground to the best advantage, may be able to so far approach the position that they can make out details. This method was almost always neglected by the English, although the necessity for a more accurate scouting both for infantry and cavalry repeatedly showed itself. Here infantry officers' patrols must do the work, who, ensconcing themselves

under cover before the position, must examine the country with good glasses, calculate distances, and signal their observations by means of flags. By such so-called patrol-groups the advance of their own infantry under fire, even over wide distances, can be assisted.

When the position of the enemy is approximately ascertained, a further extension of the fighting line takes place. On the 18th February, at Paardeberg, four out of the five battalions of the 6th Division were at once moved up into the firing-line. Each battalion of eight companies occupied a front of from 400 to 500 yards, formed in three lines, of which the two first were in skirmishing order, with intervals of about two yards, the third line consisted of two or three companies in close order. The whole front of the four battalions covered more than 2,000 yards.

The Highland Brigade, on the right of the 6th Division, went, however, further in the extension of their fighting front. Towards 7 a.m. they broke up their bivouac east of Paardeberg Drift, and advanced in an easterly direction, the Argyll and Sutherland Highlanders leading, followed by the Black Watch and the Seaforths, at a distance of some 2,500 yards from the enemy's front, in long ranks one behind the other with four paces interval between the men, until the head of the Argyll and Sutherland Highlanders had arrived level with the artillery · ı Gun Hill, behind the left wing of the 6th Division. Here, after turning left about, the whole brigade, except two companies of Seaforths, who followed behind the left wing, advanced over the open plain towards the river in an extended, weak skirmishing line, with a front of more than 4,000 yards without supports and reserves. The English, without doubt, went too far in broadening their front; but the new weapons undoubtedly permit an extension of space in the attack of single units, which, however, must be less than in the defence.

In possession of a long-range weapon, fitted with a convenient, long-distance sighting arrangement, the English infantry allowed themselves to be enticed, by the distant fire of the Boers at ranges from 1,200 to 1,300 yards (the Guards at Modder River), even 1,600 to 1,700 yards (6th Division at Paardeberg), into opening fire on the enemy, whose position could not be detected even with the most powerful glasses.

The complaints, recurring again and again in all reports, that it was almost impossible to discover the enemy, who lay motionless behind their cover, shows the necessity of training the eyesight of officers and men in detecting difficult objects at medium and distant ranges. The battles in South Africa confirm the old rule that if an attacker has once opened fire at long range, he generally does not get within close range. To at once throw oneself down to return it, when the enemy opens fire, shows how fatal peace training is. The losses were in any case small, certainly not in any way comparable to those suffered by our Guard in the advance against St. Privat through the effects of the Chassepot fire, without being able to return it. Small losses must be borne, until heavier losses make it necessary to open fire with individual units, in order to make the further advance of the main force possible.

Just for these duties machine guns have shown themselves very useful. Every English battalion had one of these weapons. Whilst in the Soudan these guns were used as batteries against the dense

masses of the Dervishes, in South Africa they were used with the battalions. Often there was no opportunity for using them, which was left to the discretion of the commanding officer. When attacking it was difficult to get the weapons on the carriages on which they were mounted forward, as they offered a mark like a gun. It was not without reason that an officer said:—"It was as if their outward appearance had made leaders and men alike forget that they had in their hands a weapon of the limited efficacy of these guns." As the Boers never offered good targets for machine gun-fire, the troops were dissatisfied with the effect they produced. In the attack on Talana Hill a machine gun proved very effective in a small wood behind a wall; in open country the guns were, however, very quickly silenced. This, for example, happened at the Modder River to the Scots Guards' gun at 900 yards, at Magersfontein to the Seaforths' at 600 yards, also at Rietfontein on the 26th October, 1899, the Gloucesters' guns at about 900 yards.

Wherever the attempt was made, the English infantry in their skirmishing lines were able to advance with only small loss to a distance of between 700 and 800 yards from the enemy, then, however, these thin firing-lines showed undoubtedly themselves much too weak, either to advance further or to gain undisputed fire superiority. The new English regulations therefore lay down that in their skirmishing lines, with intervals of 6 to 20 paces, when a distance of 600 yards from the enemy is reached, the line is then to be brought up to full strength, that is, a man to every yard. It is considered an advantage of thin skirmishing lines that they suffer less from fire, that each man has greater freedom of movement, that they are more difficult to locate, that presumably the enemy will also open fire upon them later. But certainly there is some ground for stress being laid upon the fact, that a man's sense of duty, who in the thin firing line suddenly finds himself exposed to danger, wavers sooner than when he sees his comrade close to him in the action.

The question whether on principle thin or close skirmishing lines are to be employed does not permit of a definite answer. Our duty must be to bring into position a firing-line superior to the defender's at close range. If we have to advance through country with cover, which interferes with the effectiveness of the enemy's fire, we immediately enter upon the decisive fighting, and we must utilise the advantage of a uniform bringing up of skirmishing lines possessing fire superiority; if we have to advance over open country nothing remains but to move forward with thin lines, gradually strengthening them to the fullest extent. Stress has been laid upon the point that in this advance in several lines one behind the other the units will get mixed, and that also the rear lines might fire upon the advanced ones. The first point must be conceded, the second, at least as demonstrated by the war in South Africa, affords no ground for apprehension.

Doubts have also been expressed whether the reinforcements can reach the firing-line. The war in South Africa proves this. At Magersfontein the Highland Brigade, holding on to their close-range positions, were reinforced by a battalion which advanced by rushes and even succeeded in gaining another stage in advance; at Paardeberg a half battalion of the Cornwall Regiment were equally successful, reaching the firing line partly by creeping and partly by rushes. In general, it is recommended that the reinforcements be brought up by rushes to

about 200 yards of the firing line, the last stretch to be crossed by the men creeping, as soon as they arrive within the fire zone directed against the skirmishing line. At what distances the principal fire position will lie depends upon the nature of the ground and the results of its examination, as well as upon the efficacy of the enemy's artillery. The attack to-day consists, above everything in winning fire positions. Every precipitate advance from these, if the fire of the defenders is not yet weakened, may even lead to the destruction of the attacker. This struggle, with all its disappointments and repulses, may last for hours, and even throughout an entire day. The attacker will be forced to try and adapt himself to the tactics of the defence, and he may even, under some circumstances, have to entrench himself. Thus the chances of the attack and defence are gradually more and more equalising themselves, although it is certain that as the battle progresses, the moral superiority of the advancing attacker will increase proportionately as the defender on his part begins to bleed to exhaustion.

When once the fire of the defender has been weakened, the further progress of the attack must vary according to circumstances. The view has been chiefly held that the best method of advance is by rushes by companies, as soon as reinforcements have reached the firing line.[1]

But these reinforcements, having worked themselves forward into the enemy's fire without firing a shot, would plainly be glad to be able to at last open fire. Were the strengthened line now to spring up, a heavy fire would be directed against them, which would soon compel them to throw themselves down again. If a rush is to succeed, the fire must first have been effective for some time; all regularity of movement must be discarded.

The section leaders must independently take advantage of every opportunity to bring their men closer to the enemy. It is just in this, that English officers so often failed. Any preparation taking time, which the simultaneous rush forward of long lines especially calls for, is, as it attracts the attention of the enemy, bad. Quick as lightning must the springing up from the ground and the rush forward follow each other; whether the men move with their breech-blocks open, with loaded or unloaded weapons, is immaterial. In the rush forward the men are generally too much out of breath to shoot immediately; rapidity of movement is the main thing.

Indeed, in the Franco-German War we experienced increasing difficulty with each rush in making the men rise quickly and carry their rush forward far enough. English officers fully bear me out.

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[1] In the "Militärischen Betrachtungen über den Krieg in Sudafrika" (Beiheft 8, *Militär-Wochenblatt*, 1900), the following observations occur:—"The men do not all rise together; this gives a watchful enemy time enough to greet those who get up last with a well-directed fire. Accordingly, even short rushes with long lines become too costly to be carried out for any length of time. Small groups, on the other hand, can be put in movement almost immediately, and surprise, in my opinion, is the only thing that can guarantee a rush success. For this reason it should only last as long as the surprise. Everything likely to attract the attention of the enemy by a sudden cessation of fire must, therefore, be carefully avoided. And this is alone possible with small groups."

It is obvious that on principle the rushes must be as long as possible, so as not to have to repeat oftener than necessary what is the critical and the most difficult moment to be got over. This is the view taken up by the new Austrian and English Regulations. The extent of the rush is limited by the staying powers of the men and by the enemy's fire. It will be easier to shorten the rushes than to prolong the short ones to which the men have been trained. If under favourable circumstances a rush can be some 80 yards long, it will come down to 40 yards or even less at close ranges. It is of decisive importance for the length of the rush, whether the losses occur when the men rise from cover or whether during the rush itself. In the first case there will be often no rush forward at all, or the men will throw themselves again to the ground after 10 or 15 yards.

This small success in winning ground does not compensate for the waste of moral strength in making the men get up quickly. Creeping forward, however, comes quite naturally in the field; the men get over the ground more quickly, with fewer losses and without great fatigue. The difficulty of getting troops to storm under these conditions is not experienced. In the open country this creeping forward was carried out in spite of a steady fire. English officers assert that it is practicable to support these units while they are creeping forward by firing over their heads.

The Boers in this way often succeeded in driving the already disorganised enemy out of their positions by means of their rifle fire. The firing line, continually firing, crept forward slowly and steadily in a way which is said to have exerted upon the defenders, who were tied to their positions, an impression all the more disquieting and paralysing the nearer the uncanny, creeping, firing serpent-like line approached them, and the less they were in position to inflict perceptible losses on these small prone objects, especially when they themselves were kept persistently under an effective fire.

The war shows, in opposition to the view held in our Field Service Regulations, that firing lines can lie opposed to each other at close ranges by the hour without any decisive blow being struck. English officers find an explanation, which is also confirmed by their opponents, in the circumstance that the Boers could fire at close ranges without raising their heads from cover, and only left their protecting cover if the English rose to advance. At Spion Kop the firing lines lay only about 250 yards apart from sunrise to dark.

In other cases, when the Boers had gained the fire superiority, they still waited and continued the fire. The English troops could scarcely have held the position against an advance to storm. As this did not follow—rising up and retreating was synonymous with destruction—their power of resistance relaxed during the long fire action, and in order to get out of this apparently unbearable position, which was becoming more acute every minute and paralysing every vigorous resolve, the only possible alternative seemed to be to lay down their arms. It only needed some trifling incident to have sent them flying in wild confusion. It is just in this that the importance of the storm attack lies. An energetic enemy does not give ground to lead alone; he will not willingly expose himself to certain destruction from a pursuing fire; he needs first the advance of an attacker determined to come to hand grips to force him to evacuate his position. The attacker will advance by rushes and creeping as near as possible to

the defenders; any premature forward rush, any isolated advance of single units may jeopardise what has up to then been a success.

It is just here that disappointment over the exact effect produced by weapons is easy. The silencing or weakening of the enemy's fire gives only a deceptive check—an error which generally avenges itself by destruction. It appears to be somewhat hazardous to place the power of sending the men forward to storm in the hands of anyone, especially in those of the youngest section leader. To wait and keep up the fire is nearly always better than a premature rush forward. At Driefontein men advanced to storm when they saw some of the units break away from the firing line. At Elandslaagte, on the other hand, there was a feeling in the whole line that the decisive moment had arrived, and that they must either go forward or back.

"But how is the storming to be carried out?"

The one thing certain is that an advance without fire support is impossible unless the defender evacuates his position with the bulk of his men. For a certain time the artillery can well afford this support, but after a time it must cease, or better still, direct its fire upon the ground behind the position in order not to endanger its own infantry. Perhaps the defenders will remain under cover. But how if they rise, or how even if they only fire in a horizontal direction without rising? English attacks have failed even when the stormers had arrived within from 50 to 80 paces of their goal. The Austrian Regulations, recognising the value of fire support, have decided that one unit should remain lying down; but this appears hazardous, when the beat of the drums and the bugle puts everyone in motion. What, then, finally, can a single unit effect, even for the front of a battalion? Are the men to throw themselves down and take up the fire combat again if the enemy opens his rapid fire? May this not be the beginning of a repulse? What will become, then, of the units which have been driven back?

This cannot be the solution. The enemy is worsted in the fire combat, that is, he attempts to protect himself against the storm of bullets and shrapnel hurtling over his cover. During this storm the enemy must be kept under cover and not permitted to again raise himself. This appears only possible through regular conventional fire carried out at the commencement of the movement. To propose using this against an unshattered enemy under cover in order to worst him, as has been recommended several times since 1880, spells destruction. Here the question is only with regard to the further keeping in check defenders already broken. In the South African War success was several times achieved in this way.

One of the most distinguished and perhaps the best tactician of the English generals, Sir Ian Hamilton, who led his troops against the enemy at Elandslaagte and Doornkop, wrote to me as follows on this question:—"My view is, that no matter what Regulations are laid down in peace, men will fire when advancing to storm. Nothing will stop them; they rely upon it. It is as well, then, to count upon it in advance. The greatest danger is that the men will throw themselves down instead of continuing to advance. When stormers once lie down, they only get up to retreat."

The views of English officers, who are most experienced in war, certainly deserve consideration.[1]

[1] Von der Goltz writes in his "Training of Infantry for Attack":—"The nearer the line approaches the defenders, all the more does the inherent effort of everyone show itself, to reach the enemy's position as rapidly as possible; from lying down to shoot comes the kneeling, then the standing to fire, and finally quite naturally follows firing while moving. Firing when in movement is permitted by the regulations, and is certainly ordered in these circumstances. There arises here a very natural feeling not to allow the enemy who is kept lying down to get up again. This fire when moving must not be confused with the former firing in movement of long lines of skirmishers at distant ranges, which was condemned in its day, and by which the keeping down of a worsted enemy, was not intended, but the overthrow of an intact one."

(To be continued.)

THE FUTURE OF THE SUBMARINE BOAT.

By Mr. ALAN H. BURGOYNE.

Wednesday, 8th June, 1904.

Sir W. WHITE, K.C.B., LL.D., F.R.S. (late Assistant Controller and Director of Naval Construction), in the Chair.

[*The Editor regrets that Mr. Burgoyne was unable to supply Illustrations for publication with his lecture.*]

THE subject of the paper that I have the honour of reading before you this afternoon is one that has, during the past few years, been receiving more than usual attention. Prior to the launch of the "Gymnôte" on September 24th, 1888, very little thought was given to the development of the submarine boat as a factor in naval warfare, and all accounts of French successes were received here in England with a scepticism which even yet is very pronounced in certain quarters. There may perhaps be several of my listeners who still discredit the value of this class of vessel, and I shall be particularly interested to hear the reasonings of the many experts present for and against their adoption as units in modern fleets of war.

But whatever the feeling on the matter may be, the fact remains that almost every Power possessing a Navy has taken up assiduously the study of under-water craft, and in the majority of cases has built one or more submarines as additions to the fleet. We are told that they are still in the experimental stage—this point I concede, for when does the experimental stage end? Surely our early battle-ships were in the experimental stage as compared with the mastodons of the "King Edward VII" type, and these, no doubt, will be as little similar to the recognised battle-ship 30 years hence as the "Alexandra" of 1875 is to them. The point to consider, therefore, is not whether submarine boats are still in the experimental stage, but rather whether they at present possess an offensive value for war purposes. And there is no one, I think, who will deny them this value—an almost unknown value, it is true—yet undoubtedly they will have to be reckoned with in future naval wars. We must always bear in mind that the torpedo-boat did not begin with the destroyer, nor did the life of an iron-clad open with a "Commonwealth." All vessels of to-day are but the evolution of time, and the smaller the beginning the greater the finality. Already it is hard to believe that whereas in 1890 the French possessed only the "Gymnôte," of 30 tons, now, fourteen years later, they have six submersibles of no less than 422 tons on the stocks. We in England were somewhat tardy in our adoption of this novel type of war vessel, and, as a consequence, are not only behind several other Powers in numbers, but also in efficiency. Because the submarine boat does not appeal to the British mind, it is no reason

why England should not possess them, given, of course, an efficient type.

It is by no means an easy matter, in a prognostication of the future submarine vessels, to draw any direct conclusion from the experiments that have been made with those at present in existence, yet the secrets of the future can, to a certain extent, be fathomed by a careful study of their history in the past. I endeavoured in a recent article with the same title as that of my paper to-day to express my ideas for the future submarine, but in the limits of a few columns it was impossible to arrive at any definite issue. History gives us a long line of inventions, none of which can be designated "successful," in the true meaning of the word. Of course, gauged by the scientific knowledge of the period in which they were conceived, many of the designs showed an extraordinary amount of ingenuity, and there is little doubt that had Drebel been possessed of the mechanical facilities of the present day, the submarine would now be an almost perfected vessel. However, neither he nor any of his followers did possess them, and, consequently, up to recent times, Drebel's leather-covered diving-boats were, in real fact, every bit as successful, from the utilitarian point of view, as the various craft designed and built under the superintendence of Messrs. Garrett and Nordenfelt twenty years ago, or even the more recent small Goubet boats.

Let me try and define the perfect submarine as we would have it in our Navy.

"It would be a vessel of special type, the shape to be determined by experiment, but with no speciality of form essential, capable of navigating not only on the surface, as an ordinary ship, but also beneath the surface of the sea, and continuing its course in a direct line for the object it is desired to reach, whilst retaining stability in every sense and being under the complete control of its commander; and besides conforming with these conditions it must possess the maximum of speed, safety, offensive power and habitability, a trustworthy means of propulsion, and a complete independence of all exterior help while in action."

With this definition before us it is a simple matter to divide up the various problems of submarine navigation into sections.

Form.

The first of these sections I place under the heading "Form." If the effect of form is important in the calculation of resistance to surface vessels, it is doubly so in submarine craft. But whereas in ships on the surface the wave-line is, I believe, the leading feature to be studied, with submarine vessels this naturally required less consideration, the chief point in view being to obtain a form conducive to stability.

Stability in a submarine boat might be defined as the keeping of such craft on a level keel and counteracting promptly and effectively any endeavour on its part, should it dive, to follow the line of least resistance.

On the surface, a vessel in motion throws off waves, and these disperse on either side at an ever widening angle until the force of contact with the vessel shall have become nullified and the wave subsided to the ordinary surface condition of the water. It will be seen that there is here a considerable amount of wasted energy, for in return

for the power expended in cleaving the water the ship receives very little or no help in its forward motion. Let us take the case of the submarine. When such vessels divide the water, the displaced fluid, being unable to follow the course of the surface waves and radiate (owing to the incompressibility of the ambient water), closes in behind the object in movement. We thus see that a great deal of the energy expended in parting the water in the bow is made up by the forced return thereof to the position it had held prior to meeting the resistance of the moving vessel, and in so doing aids the onward movement of it. Now the gain or loss of such help depends solely on the form or "run" of the after part of the boat, and it is alterations in the shape of this portion that will govern the entire outline of future submarine boats.

[The lecturer here exhibited slides of six sketches of the chief forms adopted in the construction of subaqueous vessels:—

No. 1 showed the symmetrical form adopted in a large majority of boats; amongst these may be mentioned the "Gymnôte" (as represented), "Goubet," "Baker," "Rutley," "Philippeau," "Freese and Gawn," "Piatti del Pozzo," "Forrest," "Peral," "Waddington," and "D'Allest."

No. 2 represented a fairly common type of dissymmetrical vessel, which includes the "Plunger," "Drzewiecki," "Katahdin," "Lecaudey," and "Tuck."

No. 3 showed the shape peculiar to the well-known "Holland" boats, the chief feature thereof being the position of the greatest diameter. Another very similar is the invention of "Lacavalerie."

No. 4 represented the shape the lecturer has adopted in his armoured vessel, and combines the excellent form of the "Holland" with the flat resistant upper surface of the "Gustave Zédé."

No. 5 showed among others the "Gustave Zédé" and "Morse," which vessels have a form in the bows, in the lecturer's opinion, much more conducive to surface stability, a quality more valuable in a submersible than in a true submarine.

No. 6 showed Mr. Nordenfelt's ill-fated Russian submarine boat, which, however, was too much of a surface vessel to be an efficient submarine.]

The lecturer then proceeded to discuss each of these in turn, and continued: — In the "Gymnôte" we have a form which, while possessed of little longitudinal stability, represents the maximum of resistance. There is nothing so capable of withstanding enormous outside pressure as a sphere, and next in strength comes the double-ended cone. For the exploration of great depths, therefore, the form adopted by MM. Gustave Zédé and Goubet presents every advantage, but I fail to see the value of this advantage, if such it be. The "Goubet," as we know, is capable of withstanding the pressure at a depth of about 5,000 feet, or very nearly a mile beneath the surface; our own "Holland" is capable of navigating safely at 150 feet. The difference is astounding, even if we allow the "Holland" a margin of safety equal to 850 feet (an altogether disproportionate allowance); the "Goubet" is yet five times as capable of withstanding external pressure as the American boat. The value of this immense strength is, however, not apparent, and there is little doubt but that any advantage it may confer is negatived by the lack of stability attached to its form. The reason of this is easily comprehensible. The vessel is circular in section from stem to stern, and is balanced

as a beam by its preponderance of weight in the middle. Now this all-round equality of sections renders a see-saw motion in the longitudinal sense the easiest possible thing, since there is no variation of resistance at any point, and differentiation in the locality and distribution of such resistance is a greater step towards stability than the actions of rudders and changeability of water ballast can ever be. Thus, if a member of the crew of a symmetrical vessel walks forward and so causes the bow to dip, the resistance of the water to the lower contour of the forward part of the hull is equal to the resistance of the upper part of the stern section, and the diving angle of the vessel being even over its own length the deviation is not likely obviated, and a swing motion is set up which, besides being dangerous to the vessel should the depth of water in which she is navigating be little, is decidedly unpleasant to the crew, whose pluck and, hence, value would soon disappear under the prolonged tension of essaying to keep their craft on an even keel. The Turkish sailors absolutely refused to serve on the "Abdul Hamid" and "Abdul Medjid," owing to their switchback-like movement when submerged. Of course, this defect in stability is not irremediable, for in the "Goubet" we find the acme of stability, and yet she is of the symmetrical form. This is owing to the height of the centre of buoyancy and the size of diameter as compared to the length. Thus it was only natural that faults which were prominent in the "Gymnôte" should be accentuated in the "Gustave Zédé," a vessel of far greater length with little additional beam. Therefore, the shorter a symmetrical-shaped vessel is as compared to its diameter, the nearer does it approach a sphere weighted at the bottom, and the greater will the stability be. But in obtaining this necessary stability the fine lines essential to speed disappear, and speed is of almost as much importance as evenness of route when submerged. If a compromise is effected, we obtain a vessel faster than the "Goubet," but less stable. Such a boat is the "Gymnôte," and the "Gymnôte" in all probability represents the final phase of the symmetrical submarines.

Let us see whether we have made any advance in the shape represented by No. 2. This form was adopted for the "Plunger," an armoured American submersible, which is at present lying in a small harbour on Long Island, 170 miles from New York, a mere hollow shell. It is no novelty as regards design, having appeared in Professor Tuck's two boats, both of which, it will be remembered, were failures. The same remarks made of No. 1 apply to No. 2 therefore, since we find in the "Drzewieckis," vessels almost analogous to the "Goubet," having their great stability but lack of speed.

In the "Holland" we have perhaps the nearest approach to Nature's submarine—the fish—that it is possible to obtain. The heavy forward part and the fine, diminishing tail are the great features of all the Holland craft. This form is so stable that oscillation is entirely absent when submerged, especially in the first "Holland" designs which are short and stumpy. For although the weight is unevenly distributed, the equilibrium is perfect, owing to the fact that in the bows, which support the major portion of the weight, the buoyancy is greater, and can thus sustain it, whilst towards the stern the gradually diminishing surface of the hull reduces the buoyant power and thus equalises the pressure evenly over the whole length of the vessel. It will have been noticed that the sharp pointed bow has

given way to a blunt nose, and this is due to the same reason that changed the form of the stem of the Whitehead torpedo from a point to a spherical cone. It was found by experiment with models in a tank that the sharp nose, strange as it may seem, offered infinitely greater resistance to the water when in motion than an equal sized model with a rounded, blunt nose. This phenomenon may be roughly explained as being due to the difference of flow of the liquid wave of motion when caused by a sharp point and a blunt nose; thus, if a sharp point pierces the water, the fluid is "forced" on either side and strikes out at an angle away from the hull, whilst with a blunt and smooth stem the water "glides" away from the impact and swirls smoothly "round the lines" of the hull instead of wasting its energy on the ambient water in an ineffectual effort to compress the same. This argument does not apply to surface vessels, owing to the difference between "surface wave resistance" and "submerged wave resistance." As a matter of fact, it is erroneous to say "submerged wave resistance," there being no "wave," but for want of a better term the word "wave" will stand very well for the radiating lines of moving fluid displaced by a submarine boat in motion. On passing the thickest part of the boat, which is about a third of the length from the bows, the flowing water, rushing sternwards to fill the cavity out of which it has been forced, presses tightly on the receding lines of the hull, and the longer the stern "run" (that is, from the greatest section to the propeller) is, the greater is the length of time that this pressure is exerted; the velocity of the backward flowing current is likewise augmented increasingly as it reaches the end, and these two causes (the rapid flow of the displaced water and its pressure on the hull) help the forward motion of the boat and make up almost entirely any power lost through resistance. Of course, it would be foolish to say that the ideal shape had already been discovered, but the "Holland" is very nearly all that can be desired. An ideal submarine vessel would be one in which the frictional resistance was completely made up by the sternward pressure, but this is as likely of attainment as universal peace.

The shape represented by No. 4 is an endeavour to combine the best features of the "Holland" and "Gustave Zédé." Like the "Holland" in every other particular, this vessel is provided with bows very similar to those of the "Gustave Zédé," and whilst perfectly fitted for submarine navigation possesses the additional advantage of being a good surface boat owing to the torpedo-boat stem. This, in a submersible, is of the utmost importance, and it is therefore strange that the "Holland," which is as much a "submersible" as a "submarine," should have the bows of a true "submarine," and that the "Gustave Zédé," which is a true "submarine" boat, should have a stem more suited to a "submersible."

Passing on to the "Gustave Zédé," we find a fault at once—a fault, however, which the skilful engineering and inventive ingenuity of our neighbours have been able to counteract. This fault is too great a length in comparison to the diameter. The more this is so, the more must the movement of the vessel in the longitudinal sense savour of the switchback. Any weights at the ends tend. if decreased or augmented, to utterly destroy the equilibrium of the vessel, the leverage being so infinitely greater than in a short, deep boat. Hence, when first tried, the "Gustave Zédé" progressed in long, sickening

dives, the stern rudders, or planes, being totally incapable of keeping her on a straight course for two minutes together. The addition of two other pairs have now made this submarine-boat one of the most efficient in commission, her movements being wonderfully steady.

Of the "Nordenfelt" we will not speak. We know that she rocked like a beam every time she was submerged, and that no power on earth would keep her on an even keel. Her disastrous end off Jutland is a matter of history.

Stability.

Now comes the question of stability again.

The stability of all submarines is governed by their reserve of buoyancy when submerged, for it must be taken as an axiom that every submarine vessel claiming to be successful is stable in its surface condition. The relation of "size" to "reserve of buoyancy" hardly needs discussion, for obviously where a vessel of, say, 500 tons can have a "reserve" of 40 tons, one of two tons could scarcely reserve as many pounds. Hence, whilst the movement of a man fore or aft must in a smaller boat completely destroy the equilibrium, in the larger his weight would be so small a part of the "reserve buoyancy" (tending, as such does, in all cases to preserve an even keel) that the movements would have a scarcely appreciable effect. This point of view applies solely to submarines, thus giving to submergible vessels an extra reason for increasing the displacement, in addition to all those leading to the same tendency in surface ships. These, roughly speaking, are:—Increase of speed, defensive and offensive power, sea worthiness, strength of structure, and radius of action. To obtain one or other or all of these things, each class of vessel represented in any Navy in the world, has, following the trend of modern improvements, gradually been augmented in bulk.

Displacement.

The following table gives further testimony to my statement. In it I represent some of the earliest and more recent types of all classes of vessels.

Battle-ships.

La Gloire (1859) Displacement: 5,650 t.	Colossus (1882) 9,420 tons.	Repulse (1892) 14,150 tons.	Connecticut (1903) 17,770 tons.

Cruisers.

Comus (1878) Displacement: 2,380 t.	Arethusa (1882) 4,300 tons.	Blenheim (1890) 9,000 tons.	Terrible (1895) 14,200 tons.

Destroyers.

Havock (1893) Displacement: 240 t.	Zebra (1895) 310 tons.	Arab (1898) 430 tons.	Dee (1903) 550 tons.

Torpedo-boats.

No. 17 (1877) Displacement: 33 t.	No. 79 (1886) 75 tons.	No. 19 (1894) 130 tons.	No. 113 (1903) 194 tons.

Submarines.

Gymnôte (1888) Displacement: 30 t.	Gustave Zédé ('99) 266 tons.	Omega (1903) 301 tons.	Emeraude Class (1905), 422 tons.

Some may be disposed to quibble at my selection of ships—they are made at random; nevertheless, that the displacement has been augmented in every class is an indisputable fact. This being so, we can discuss, on behalf of the submarine, the reasons that have led, and will lead, to a still further increase in bulk.

Firstly, in the surface ship, comes offensive power. Whenever a nation laid down a new ship, one more powerful was immediately designed by the other naval Powers as an answer to it. This "increase in power" usually took the line of more guns, requiring greater ships to mount them. If the speed were equal, that was deemed sufficient. With the submarine, then, one of the causes that will lead to its being increased in size will be the necessity of adding to the very meagre armament, for at present submersibles are the least armed war-ships in the world. In answering the question: "What direction will the increase of armament take?" I shall make a statement which I do not expect one naval man in a thousand to uphold. It is this:—

The submarine, in common with the surface ship, must and will carry guns.

The reasons for this will become obvious as we go further into the discussion as to why the submarine will become gradually bigger. Its defensive powers must also be increased, and how can one do this with a submarine, except by adding armour—*i.e.*, an armoured deck! The augmented defence, however, is only correlative to guns, since, to use the latter, portions of the boat must be exposed, and these need protection.

The next consideration is speed. Here we are on surer ground, for obviously the snail-like 8 knots of our first batch, or the 14 to 15 of our latest lot of submarines can scarcely be looked upon as the acme of speed in this type of vessel. Now all the submarines up to to-day (with the exception of the "Protector," "Peral," and "X," designed by Romazzotti) have been driven with single screws; I need scarcely refer to the advantages from the speed point of view of twin propellers over the single screw; it is not only an acknowledged, but also a proved fact that two are in every way superior. But twin propellers necessitate two engines; couplings off one engine might be arranged, but not without loss of power, and two engines mean more space, and more space requires a heavier displacement. Besides increased engine power there must be further additions to the fuel or oil, for we know how the consumption of this essential commodity rises in leaps and bounds with every knot of increased speed. Yet with all these things taken thoroughly into consideration, there is no reason why a large submersible should not have a surface speed of twenty-six or even thirty knots. We must remember that the Russian Nordenfelt submarine steamed at over twenty knots on several occasions. To the speed under water I attach but small importance; to the armoured and armed submersible of the future the present "totally submerged" speed of seven or eight nautical miles will be ample. All the quick work will be executed on the surface after the manner of torpedo-boat destroyers. It would be well here to revert for a moment to the form—more especially the shape forward. The present type of bow, a bluff, torpedo-shaped semi-sphere, is useless for surface speed, for, as anyone who has been in a "Holland" or has seen one at sea knows well, the tendency is to dig downwards, there being a continual contest between the buoyancy of the boat and the wave which surges up the

sloping bows. But as noticed already, the bluff, full bow is best for submerged work.

What, then, must the future bow be? Obviously a compromise, for it would never do to give a submarine the bow lines of an ordinary surface vessel. The two types must in some way be conciliated, and this will be rendered the easier if the chief importance be attached to surface work, where great speed will be necessary. The "Protector" has a ram bow, Cæsar Laurenti's "Glauco," building at Venice, has a straight up and down torpedo-boat, and the new French submersibles are similar, but have a slight turtle-back deck. Experiment alone can determine which will be the best, but I favour that of Signor Laurenti, though in large vessels a ram might be used as a last resource.

Armament.

Now, having found the ideal shape and motive power, we come to the discussion of the use of guns and armour. The submersible of, say, twenty-six knots will be able to pursue or fly from any battle-ship or cruiser, but will be open to attack by surface torpedo-craft or other submersibles. The reason of this is that as the submersible increases in size so will the time required for complete submergence become longer. Hence, to protect itself against torpedo-boats or destroyers during the filling of tanks, there must be a quick-firing armament, and the future submersible boat will carry a battery of 12-pounder and 3-pounder Q.F., much as do our destroyers to-day. In fact, they will be destroyers, but capable of submergence, "fully," if badly pressed, "partly" for entering action, and thus presenting as small a target as possible. Here is where the armour deck is required, for the main work of the submersible being on the surface, her exposed parts must necessarily have adequate protection. It may be asked: "Then why not armour destroyers?" and the reply is that in a destroyer the full side would require to be armoured (and more heavily) to give the same protection as a curved armour deck in a submersible which is floating practically on a level with the surface.

Whilst increasing the armament by the addition of quick-firing guns, it will also become necessary to augment very considerably the present meagre complement of torpedo tubes. Obviously a submarine with a single tube must always remain an inferior weapon except for harbour defence. The number and position of these tubes will depend greatly on the mode of attack adopted for submarines, but in a design I shall shortly show you three tubes are provided. We have now, I think, discussed pretty fully the factors of War in the future submarine, and we will turn for a moment to the side of Peace. By this I mean the comfort of the crew and the provisions for their safety.

Safety Appliances.

It may be taken as certain that as submarine craft improve, the condition of the crew will be more carefully studied; as yet, they are, almost without exception, impossible to live in. The officers and men are forced to return every night to a home base, no bunks or kindred comforts being arranged for. In the present small submarines this is to be understood, there is no room for cabins or lockers, all available space being utilised for machinery or spare gear. Another important point, perhaps the most important, is the means of safety provided.

In the debate on the Naval Estimates in the House of Commons this year, in reply to the inquiry made by Sir C. Dilke relative to our policy in connection with submarine vessels, Mr. Pretyman stated of the type adopted by this country that: "If she sank, and water rushed in rapidly, there would be no possibility of life on board." This is an official acknowledgment of a fact already well known—namely, that submarines are fitted with no means of safeguarding against such accidents as that which caused the sinking of the "A1." One of the first points in connection with submersible craft is to see that they possess means of defence as well as offence. Their peculiar mode of attack necessitates defensive appliances somewhat apart from those employed in surface vessels. On the surface, armour belts, protective decks, and minute sub-divisions are employed, the object of these measures being more as protection against attacks by an enemy than against accidents. In the case of submarines, their power of submergence is their best defence against the foe, and it is therefore to the minimising of fatal results in the event of an accident that the efforts of constructors should be directed. In view of the attention paid to this subject at the present time, the following possible means of safety may be of interest:—

1. Our submarines are open from end to end, and hence a single breach fills the whole vessel. They might very easily be sub-divided into seven or eight entirely separate compartments, communication between these being obtained by means of automatic water-tight doors, all capable of being closed from either compartment.

2. A detachable safety-boat, such as proposed by Bourgois and Brun in 1862 and more recently by myself, capable of holding the entire crew, and possessing sufficient buoyancy to rise when detached to the surface could easily be fitted. This should have hatches in two or more separate compartments to add further to the chances of escape for the crew.

3. The conning tower of a submarine must in every case project from the deck line of the hull, and hence, when submerged, prove a source of danger, as the accident to "A1" has recently shown. When below the surface the conning tower is useless, and all operations connected with navigation could perfectly well be carried on within the hull proper of the submarine. This being the case, a horizontal sliding steel door might be fitted level with the deck, which, on reaching the depth at which the lid of the submarine became immersed, automatically shut off the conning tower from the interior, thus, in case of a leak therein, preventing a rush of water into the hull. Further, as the displacement of submarines increases, the conning tower could be rendered telescopic, and when not in use lowered to the level of the deck.

4. All our submarines are of positive buoyancy—that is to say, they possess a buoyant reserve which, were it not for the mechanism employed to keep them submerged, would bring them up to the surface. The reserve however is a very small percentage of the total displacement, and in the "A1" class is altogether inadequate. In certain foreign vessels one to three metal weights are recessed in the hull, each of which can be detached by a half-turn of a hand wrench. Obviously the sudden release of, say, a ton from the vessel's displacement causes it to shoot to the surface and, as has been proved by experiments in France, even a leak has not time to overcome this sudden lightening, if it be attended to immediately.

5. In the event of our submarines being entangled at the sea bottom, or for some reason unable to rise, their commanders possess no means of informing their friends above of their predicament. They should each be fitted with one or more small buoys capable of being freed by the withdrawal of a retaining iron rod, and, further, connected telephonically with the interior. This would allow the imprisoned men to explain their position and give their ideas as to the best methods to employ for their release.

6. All French submarines and the majority of those built by other Powers are fitted with four eye-bolts: two on either beam forward and two aft. After an accident a salvage steamer anchors in position above the submarine at low tide, and chains are let down on either side, clamp hooks at the ends being rapidly placed in the eye-bolts by divers. As the tide rises the hull is raised from the sea bottom, and the salvage steamer makes its way into harbour. Indeed, owing to the density of sea water, it should be possible, having once secured a firm hold, to haul the submarine up by steam capstans until the conning tower touched the keel of the salvage vessel; like this the submarine might be taken into dock.

To carry all these things—armour, guns, larger engines for increased speed, more room for fuel, extra torpedo tubes, safety appliances, etc.—a greater displacement is therefore essential. Our latest vessels, "A2," "A3," "A4," have been given a second torpedo tube and a higher speed by six knots than their forerunners, but to obtain this the displacement had to be nearly doubled. Yet even their 200 tons is not sufficient—France is already approaching the 500—and I hope soon to hear of submersibles of six to eight hundred tons (submerged displacement) being ordered. These would be approximately the size of our destroyers, for, be it remembered, if one of them were submerged to the deck, at least 250 tons would be added to the weight of water displaced.

I feel convinced that we are on the eve of a revolution in naval construction, and that in the near future we shall hear of submarines or, rather, "submersibles," of thousands of tons. I may be ridiculed as I was when I first took up the subject of submarines; one renowned naval authority then assured me that the submarine was destined to be snuffed out like the dynamite gun—when I saw him six months ago his opinion had strangely changed.

What the *eventual* type may be, I dare not prophesy, but I venture to show my own idea for a small armoured submersible. This plan is, of course, very rough, but for all discrepancies I plead the fact that I am unfortunately not a naval constructor.

The dimensions are:—

Length over all	...	142 feet.
Extreme depth	...	17 feet.
Beam		12 feet, with lee boards 15 feet.
Displacement ...	circa	260 tons.

The oil engine of the "Forrest" 24-cylinder type would develop 500-I.H.P., which, on the lines proposed, should give a speed of between fourteen and fifteen knots. The electric motor of 250-I.H.P. should impel it at eight knots on the surface and seven below.

I have endeavoured to introduce in it certain features mentioned in my paper.

It is essentially a "submersible" boat, and as such it will be chiefly employed in a semi-submerged state—*i.e.*, the deck on a level with the surface. To protect it therefore while in this trim, all the exposed surfaces plated with thin armour capable of keeping out all projectiles from the machine gun bullet up to the 6-pounder shell. This plating is curved downwards to the sides, much in the same way as the protective deck of cruisers, whilst from the bows it rises in the form of a turtle back to just beneath the observation ports of the conning tower, which is thus effectually protected up to that line. The conning tower being more exposed will be plated with armour twice the thickness of that carried on the other protected parts of the vessel.

This armour will naturally be a great weight on the deck, and if the displacement were not fairly large, the buoyancy and safety of the vessel would be much endangered in that the plating will be to a submarine what an excess of top-hamper is to a surface ship, and we know how much the French battle-ships suffer through carrying enormous military masts resembling lighthouses in their immensity.

Submergence is obtained by the introduction of water into ballast tanks placed in convenient positions for the regulation of weight. These are filled by means of water-cocks, and emptied by pumps or compressed air.

Stability when submerged is maintained by two distinct methods; firstly, by horizontal rudders placed in the stern and worked by an automatic adjustment actuated by the longitudinal movements of the vessel, and, secondly, by the displacement of water in a pair of cylinders situated at either end of the boat. The pistons in these cylinders are connected by a rod running the whole length of the vessel, and this rod is so geared that the simple movement of a lever will draw water in at one cylinder, whilst expelling an equal amount at the other, thus altering the balance of the boat. It will at once be seen that by this means the perfect trim of the vessel can be accurately obtained.

The armament consists of three torpedo-tubes, one forward in the bows and two others placed in the stern. For these, six 14-inch torpedoes will be carried one in each tube ready for firing, and three spare ones for re-loading. The tubes are arranged in the method described, as being in the best positions for effectual service. The mode of attack will be as follows:—The vessel will approach the enemy bows on, and when within range fire the forward torpedo, after which she could either dive and rise on the further side of the ship attacked, or else turn round and retreat the way she had come, in either of which cases the stern would be bearing, and the after torpedo tubes could be fired to ensure the destruction of the hostile war-ship.

Two conning towers are provided, one for use when navigating on the surface and another for use when submerged. The first of these is telescopic, so that when scouting a more extended view of the horizon may be obtained. It is fitted with strong lenses, which can be protected by sliding steel shutters. The second conning tower is situated directly beneath the first, and can be more aptly described as a "controlling" chamber. In front of it rises an extensible optical tube, or periscope, for keeping a straight course when submerged, and in (fine weather only) taking bearings without having to come to the surface. This, however, is so unreliable that a gyroscope, placed aft,

will be looked to to prevent the vessel from deviating by automatically turning the rudders in the direction that will again bring the vessel straight.

The vessel is further provided with three keels, one running along the bottom and one on each side. These side keels are fitted at the forward end with movable planes to aid the rudders in diving. With these three keels rolling and pitching will be reduced to a minimum.

Diving is effected by the planes mentioned above, and two horizontal rudders placed in the stern, whilst steering in the ordinary sense is managed by two rudders also in the stern, and an additional rudder of the ordinary type on the keel-line beneath the engine-room.

The form of the hull differs altogether from that of any former submarine boat. Two-thirds of its length from the bows the shape recalls that of the French *torpilleurs de haute mer*, but after that it resembles a cigar, being an ovoid pointed cylinder.

I wish to make it quite plain, however, that this design in no way represents my idea of the future submarine vessel. To sum up, roughly, it will be of large tonnage, the displacement being governed by the extent of the armament and internal fittings; of good speed, at least twenty-five knots on the surface; well armed, by which I imply from four to six torpedo tubes and an equal number of small quick firers; well protected by an armoured deck, and, lastly, well provided for in the matter of safety appliances, for it would be deplorable if the officers and men who devote their lives to submarine navigation should not be given the same chances in the event of an accident as their fellows of the upper sea; and it is due to the nation that the future policy of our Admiralty in this respect should be made public.

[The lecturer exhibited a large number of slides illustrative of various types of submarine boats.]

Captain R. H. S. Bacon, D.S.O. (Inspecting Captain of Submarine Boats): — I intervene in this discussion simply from a sense of duty to the Institution. I am not, of course, at liberty to enter into a full discussion of all the different points about submarines, but there are matters in connection with this particular lecture which I absolutely feel I owe a duty to the Institution to draw attention to. I may say that we have before us a subject which is not merely one of opinion as to whether larger sized submarines are or are not necessary or advisable to the navies of the world. That is a question which is very important, and which forms one branch of the subject. But what we must consider at the same time are the innumerable technicalities and difficulties with which the whole subject bristles the moment we begin to talk about increasing the size of a submarine boat. In order to adequately treat a subject of that sort, I would submit that whoever delivers a lecture upon it requires both practical and theoretical knowledge, and I feel bound to say that, in my opinion, the author of this paper cannot have practical knowledge, because that is only a luxury that Governments can afford, and he has not theoretical knowledge, both from his own statement in the lecture, where he says he is not a naval constructor, and also from his treatment of a good deal of the subject-matter itself. Therefore, a lecture of this sort by a man who neither has theoretical nor practical knowledge can merely be his own opinions formed from the snippings of newspapers and from the standard works, or what are called standard works—at all events, the works on the subject. But

still I noticed throughout the lecture that the author attacks the subject without a word of hesitation or doubt, and with perfect confidence in his own ideas, to settle questions which I may say have occupied the earnest attention of many brains for a considerable number of years. Now I propose simply to go through the lecture, and point out what I consider are the salient features that the Institution ought not to let pass without comment. First of all, I want to avoid all controversial matter. I am not going to enter into any subject on which there may be a question of opinion. I only intend to point out those things which are facts. Now to start with, the author's definition of what a modern submarine boat should be. He says: "It would be a vessel of special type, the shape to be determined by experiment, but with no speciality of form essential"—I do not understand this, but still, we will let it pass—"capable of navigating not only on the surface, as an ordinary ship, but also beneath the surface of the sea, and continuing its course in a direct line for the object it is desired to reach, whilst retaining stability in every sense, and being under the complete control of its commander; and besides conforming with these conditions, it must possess a trustworthy means of propulsion and a complete independence of all exterior help while in action." Now any submarine boat possesses those. The only thing he adduces that the future submarine boat should possess, which the present submarine boat does not, is maximum speed, safety, offensive power, and habitability. In stating this generally, he draws no distinction between surface and submerged speed, between surface and submerged radius of action. But in considering a question like this the whole of the future of the submarine depends upon the proportion of balance that we wish to maintain between these factors. When he says that we require the maximum of speed, you must not forget that if we have a maximum of surface speed we cannot get a maximum of submerged speed; the two are antagonistic; and, in the same way, range of action on the surface is antagonistic to range of action below the surface. It would therefore have been somewhat interesting if we had had some suggestion as to what he considers the balance of these capabilities should be. There are innumerable problems which require solving, all of them interesting, most of them debatable, and, when I first read the title of this lecture, I was hoping to hear something really interesting to-day. But I must honestly confess I have been completely disappointed. Then he goes on to say: "With this definition before us it is a simple matter to divide up the various problems of submarine navigation into sections." Before going into each individual section I would have you notice that one important consideration—I will not call it *the* one, but the *most important* consideration which tends to limit the size of submarine boats—the author has not mentioned at all, and that is the question of submerged horse-power, a question, involving, as it does, secondary batteries, accumulators with their enormous weight, their, I may say, difficulty of management, and their liability to accident. That is a very serious matter, and when you add to that the question of prime cost, and still further, and even more important, the question of annual renewals, you come across a very serious question. Taking a really good, serviceable secondary battery, if you get the plates to last five years it is a very good time. But if we have one hundred boats, it means that we must renew those battery plates at the rate of twenty batteries a year. Now, that is a very important question, and for roughly the reasons I have shown, it is one of the underlying principal features of submarine development, because as you increase in size, you must roughly increase your battery power in a *pro ratâ* extent so as to

even preserve the speed which the smaller boat originally had. This is really the main question upon which the size of submarine boats hinges. It is one with regard to which I should very much have liked to hear opinions as to the different forms of power that might be used below the surface. A very interesting subject, but I am sorry to say it is one that is not touched upon. Instead of that the lecturer goes into a long discussion upon form. I should like to dismiss the question of form in a very few words. As the author says, the form required for surface speed and the form required for submerged speed are antagonistic. That is the long and the short of it. If we increase the surface speed we must increase the length of the boat and introduce peculiar lines. Both of those are antagonistic to submerged speed. Therefore, the balance I spoke of before must come in, and you have to determine which you want the most. The question of stability, which he has made such a big point of, really does not enter into practical consideration at all. This may sound a very strong statement, but the question of shape as regards stability is a very unimportant one, because we do not have men running about inside a submarine boat when she is submerged, any more than people run about in a railway train, when there is no purpose at all for it, when going on a journey. There is no particular harm in sitting still, and people usually sit still until they reach their destinations. The question of the men moving about in the boat is not a question which comes within practical politics, because the times during which the boat may be submerged, even up to perhaps twelve hours, are not too long to warrant continual or unnecessary moving about, and it is perfectly easy to allow for a single person moving without difficulty. With regard to the "Holland" boat, I noticed one small mistake in the picture we were shown. There the conning tower was shown right forward, also the biggest section, whereas, as a matter of fact, the biggest section is about in the middle of the boat, and the conning tower is there. That rather knocks on the head the author's argument as regards shape for stability. There is another remark. He says:—"An ideal submarine vessel would be one in which the frictional resistance was completely made up by the sternward pressure, but this is as likely of attainment as universal peace." That is true—or he might have said as perpetual motion! Then, under the head of stability, we get this statement:—"The relation of 'size' to 'reserve of buoyancy' hardly needs discussion." There are very few points in submarine design which require more discussion; for the moment we increase the size, we have to consider reserve of buoyancy, both with regard to the mean specific gravity of the water and also the changing from water of one density to another. The whole question of the submergence of the boat depends upon it. He then goes on to say: "for obviously where a vessel of, say, 500 tons can have a 'reserve' of 40 tons"—that vessel would never get below the surface. At the outside the reserve could only be one ton; it could not approach 40, because, to get the boat under, its buoyancy must be overcome. There are several methods of doing that, but none can ever deal with anything like that amount. Then to end up the same paragraph we come to this: "Increase of speed, defensive and offensive power, seaworthiness, strength of structure, and radius of action." Again, no division is made between surface and submerged, which, I have said before, is the one important consideration in a design of a submarine boat. Now we come to a statement which the lecturer says he does not expect one naval man in a thousand to uphold, viz., that a submarine must carry guns. There is nothing new in that. That a submarine will carry guns is as sure as there is a sky

above us. The only question is how she will carry them, and that is a question with regard to which I should have liked to hear some remarks. You cannot stick a gun on a submarine boat the same as you can on the deck of a destroyer because you have to fight that gun, and when we hear that the use of the guns is going to be to protect the boat while she is submerging, you begin to wonder what is to become of those men if they are to work the guns when a wind is blowing, say, with a force of five to six, and they are waist-deep in water, because it seems to me they certainly could not work the guns under those conditions. There is nothing mentioned in the paper to show us how this is going to be done. Then comes the question of armour, which I will touch upon a little later, because it enters into questions of weight. Then, the lecturer says: "The next consideration is speed. Here we are on surer ground." I cannot help thinking that he found the question of the armour and the guns a little boggy. He then goes on to say there is no difficulty in getting submarine boats to have a surface speed of 26 knots. Now a statement of that sort ought to be upheld by some very definite evidence, and all the evidence I have goes directly against it. Take the case of a destroyer designed with extreme care and after many years of experiment, and yet the speed of our latest sea-going destroyers now is only 25 knots. This is a vessel that is built solely for surface speed, and, mind you, not surface speed in a calm, but surface speed under service conditions. To attain that they have had to cut away in every direction to increase the strength of the hull; they have had to build a forecastle that more nearly approaches that of a third-class cruiser, and in the end all they can get is a speed of 25 knots. Now if to that destroyer or to the best surface vessel that naval constructive science up to date has been able to build we are going to add an armoured deck, and we are going to increase the thickness of the hull up to, say, half an inch to stand the pressure of the water when the boat is submerged, and, in addition to that, we are going to add submerged horse-power, which is the heaviest factor in the whole of the boat, and when we know that if we add three or four tons to that destroyer it will pull down her speed, I fail to see how he can have hoped, at all events, from our present knowledge (and we have no right to go further), that we shall ever approach a speed of that sort with a boat that has to fulfil two conditions, or come with it anywhere near the speed of a boat that has only to fulfil one. I should like to have heard, before a deliberate statement of that sort was made, that the lecturer had some good grounds for saying such a result could be obtained. Now we come to the question of the tactical use of these boats. That, of course, is an open question; but there are certain matters in dealing with a question of this sort before practical naval men that ought to receive full consideration, and when I find that the use of the guns and the armour is to protect the boat in a submerging condition, I should like to call attention to the fact that any craft of this sort is vulnerable mainly to the torpedo. Armour can never defend it against that. That is a most essential consequence of increasing the size of the boat. This also has not been touched upon by the author. The larger we make our boats, the more vulnerable to torpedo attack they become. The longer the time taken in submergence, the more vulnerable they are to torpedo attack. So, from the tactical point of view, attack by torpedo is a great factor when dealing with the increase of size. I do not say it will limit the increase in size, but it is a question that, in dealing with such a subject, ought certainly to have been put before the audience. To say that: "All the quick work will be executed on the surface after the manner of

torpedo-boat destroyers," is merely to lay the boat open to torpedo attack, and if once a submarine boat shows herself she can say good-bye to any chance of getting her attack in, because nobody is going to wait for her. Therefore, all the quick work which has to be done must be done out of sight, not only of the ship she is attacking, but also of all the torpedo-boats, destroyers, and scouts which may be surrounding the objective. You can accept it as an axiom that a craft which is incapable through want of strength of armament or speed of defending herself from the ship she is going to attack, must have recourse to invisibility. This is shown in the case of torpedo-boats by them having to hide themselves in darkness, and it has been shown again in the case of the submarine boats, which have had to hide themselves below the surface. It is hopeless to try and get in your attack unless you can either approach unseen or have the speed of the ship you are attacking, so that you can rush up, deliver your attack, and get away again. Now we come to a question that I should really like to hear some remarks upon. It is the one point in the whole paper that really is of extreme interest, namely: "What, then, must the future bow be?" That is a point I should very much like to hear opinions upon. The question is one that a whole lecture might be written on. It is one we might debate for a long time, but it is, beyond all others, the most important point, to my mind, of the whole of the points that have been brought before us to-day. Next we come on to the question of safety appliances, and here what I chiefly take exception to is the use of the term "*very easily*." There is one thing you may be perfectly certain of—viz., that if all these things were "*very easily*" done, they would be done. We are not fools; we are told that you can put water-tight compartments into a boat "*very easily*," and boats have not got water-tight compartments. Well, either we are fools or we are not. I can say it is not very easy to do so. Of course, that they can be put in is true, but there are many other considerations to be taken into account. I do not know whether the fact has ever struck any of you that one of the main considerations in the design of a submarine boat is a knowledge of the psychical conditions of the men. It is not merely a question of taking a man and putting him into a submarine. The man who designs a submarine boat that is going to be of any use has to study his crews, has to watch his officers, and has to watch his men; he has to see the effect that a confined space has upon them, he has to watch the effect that submergence has on them, and one thing that comes out more than another is that you cannot put a man in a compartment that is too small. This is the death-blow to all little submarines—"Goubets," and boats of that sort. This is largely because of the impossibility of getting men working under normal conditions in abnormally confined spaces, and a man not under normal conditions is sure to be flurried and useless. I point this out as one of the many different, minute matters that have to be considered. The whole question of submarine boat design is not a thing you can dismiss with one, two, three, or four years' superficial study. You want to deal with it day by day and night by night and every year, carefully weighing minute details absolutely unconceived by the novice before you are really capable of expressing any opinion upon it at all. To dismiss it in an off-hand way by telling us that this is easily done, or that that could be easily done, is a little bit hard on the hundreds of people who have been for years devoting their time to it and finding considerable difficulty in doing these things. Now I go on a little further, and I find this among these salvage arrangements at the end of paragraph 4: that by turning a handle and releasing a ton from the vessel's displacement, it

causes it "to shoot to the surface, and, as has been proved by experiment in France, even a leak has not time to overcome this sudden lightening." What leak? Who is going to lay down the law as to what the size of a leak is going to be in a submarine boat caused from collision, say, and what is the use of releasing a ton from the displacement when the leak, as it might very easily be doing, is letting the water enter at the rate of four tons in ten seconds? Why should that boat spring to the surface by releasing a ton weight? That is a point to which I should like to call your attention. It is no good, in submarine boat design, to design against small and infinitesimal leaks. Those may be easily stopped. We must also take into consideration the fact that if you have an accident the chances are that it is likely to be a serious one, and that all these ulterior arrangements (which deal solely with special cases), if they handicap the boat in any other ways, are really, from the practical point of view of a thoroughly reliable and working boat under all conditions, hardly worth consideration. We now come to the question of salvage. That is dismissed in a paragraph. That, again, is apparently "*very easy.*" "All French submarines, and the majority of those built by other Powers, are fitted with four eye-bolts, two on either beam forward, and two aft." By four eye-bolts on the hull you are going to do everything. It is very much like lifting a punt in a pond. We all know that you can lift a punt in a pond, but I will give anyone a boat sunk in a sea-way where you have a swell, at all events, for ten or eighteen days in the month, when to tauten a single hawser will mean carrying that hawser away. That is a problem that is by no means so easy. It is not a thing you can dismiss in a few words, and say it is "*easy*" to get a ship of certain construction, the construction being unknown, the H.P. being unknown, over the place, and hook on to four eye-bolts and lift the boat, and, moreover, we are told: "As the tide rises the hull is raised from the sea bottom, and the salvage steamer makes its way into harbour." It sounds plausible enough, but you get your boat out there in a heavy sea, with the wind blowing and in bad weather, and you try and work. You will find a very different state of things. Then we come to, "owing to the density of sea-water," but as all the displacements are worked out for sea water, I do not think that is particularly useful. Then the lecturer says: "I feel convinced that we are on the eve of a revolution in naval construction, and that in the near future we shall hear of submarines or, rather, 'submersibles' of thousands of tons. I may be ridiculed." There is no question of ridicule about it. Let anybody who has an opinion that submarines in the future are going to be thousands of tons have it. They may become thousands of tons. No one is going to laugh at him for holding that opinion, but what we do want to know is: what are the reasons for saying they can or will be the thousands of tons? First of all, show us some reasons for getting your thousands of tons, and then show us that thousands of tons are possible; show us the lines upon which you would work in order to get your thousands of tons. Then we should have something to argue upon; but simply to state broadly that such is the case, is not very helpful. Now we come to the author's idea of his submarine boat, but unfortunately he prefaces his remarks by saying that he is not a naval constructor. What we should like, of course, to see would be his weights. We have the rough dimensions, but that is no guide. What would be a guide would be the distribution of weight, the weight he devotes to his different horse-powers, the weight he devotes to his hull, and questions of that sort. Then we should know where we were, but a mere case of feet and inches shows nothing. He recommends an oil engine

of the Forrest 24-cylinder type. I do not know whether he has ever seen one working; but from our practical experience of oil engines, you would have extreme difficulty in keeping the lubricating oil out of the cylinders—a point I should like to call his attention to before he puts any money into it, because where the cylinder is upside down you find lubricating oil getting into the cylinder itself, and it spoils your explosions. It may be got over, but I have not seen one yet working satisfactorily. Now we have: "The electric motor of 250-I.H.P." I pause to say that electric motors do not have indicated horse-power; there is no such term. He also does not give what the actual weight of the battery is, to get 250-H.P. I am afraid that in the latter part we begin to see peeping out the cloven hoof of the paper designer, which always takes the form of automatic arrangements, the one thing not wanted in a submarine boat that is to be of any practical use. I would not mind betting a considerable amount that could we see the French boats we would find a clean sweep of every automatic arrangement. As long as we have men and brains inside boats, it is far better to trust them than machinery, which is far more liable to go wrong. "Stability when submerged is maintained by two distinct methods: firstly, by horizontal rudders placed in the stern and worked by an automatic adjustment." That, I am perfectly willing to stake my little all on, would be condemned by anybody who has been inside a submarine boat. We can keep the depth of a submarine boat with the most absolute accuracy without a deviation of more than six inches by hand power; there is therefore absolutely no reason for having any automatic arrangement. Then we come to the arrangement for the stability of the boat, which is by "a rod, geared, running along the whole length of the boat fore and aft, to work two cylinders situated at either end of the boat, drawing water in at one cylinder while expelling an equal amount at the other." I wonder he does not employ the simple "Holland" method of driving it by compressed air. Then we come to the question of the conning towers—one of those the author makes telescopic. I should like to call his attention to the difficulty of keeping that gland tight, to the pressure of the water against it, and to details of that sort. I am quite certain if he tried it, after a very short time he would give up the telescopic and go back to the original fixed form. Next we come to the optical tube. That also, I suppose, means a telescopic one. There is only one thing certain about an optical tube, and that is it cannot be telescopic.

Mr. A. BURGOYNE :—It is not telescopic.

Captain R. H. BACON :—You say extensible.

Mr. A. BURGOYNE :—Yes; you can push it up and down; that is the idea.

Captain R. H. BACON :—That is better.

Mr. A. BURGOYNE :—If I had meant telescopic, I should have said telescopic.

Captain R. H. BACON :—However, the author says this optical tube is so unreliable that a gyroscope is placed aft to help to steer the boat in a straight line. Well, all I can say is that words fail me to criticise such a statement. Then come to the next. He wishes to make it quite plain that the design he recommends in no way represents his idea of the future submarine. Well, I must honestly say that I am very glad of it.

The whole end of the matter comes to this, that this Institution is more or less supposed to be a scientific society with largely practical views, and I maintain that in the theatre of an Institution of this sort anyone who reads a paper ought to come prepared with facts and figures, and give them in his paper. It is not a place in which to put forward half-digested views. It is for that reason that I felt it absolutely my duty to come here to-day, and to point out generally the paper was one I considered ought not to be given the *cachet* of having been read before this society without very serious objection being taken to many of the statements in it.

Mr. S. W. Barnaby, M.I.N.A. : — I had not intended to speak, but as the Chairman has called upon me, I would only make this remark: that those of us who are studying submarine boats are not always inclined to say what they are doing. At the same time, I should like to say that although the author may not be an authority upon the subject in a technical sense, since he has not had any technical training or practical experience in the construction of boats, still, I think we are all grateful to him for the information which he has taken the pains and the labour to collect and bring before us. I am sure Captain Bacon will agree with me in that.

Captain Bacon:—Certainly. I may be allowed to say if this had been an historical lecture, I am quite certain nobody could have done it better than the present author; but departing from the history is another point.

Mr. Barnaby :—We have all listened with great interest to Captain Bacon, who is perhaps the greatest living authority on the subject, and perhaps the only man here who has had experience of the boats under the surface. The question of power is, as Captain Bacon says, one of extreme importance, and no doubt many changes will be made in the propulsive force which is used. We have ourselves been endeavouring to get rid of the duplication of parts by trying to get one source of power which will do both for surface and submerged running. That is one of the things that is worthy of the attention of all those who are working on the subject, because the submerged speed is of very great importance, and electrical power at present is a very heavy means of obtaining propulsion.

Admiral the Hon. Sir E. R. Fremantle, G.C.B., C.M.G. (Rear-Admiral of the United Kingdom) :—I only rise to say that I entirely agree with the last speaker, Mr. Barnaby, that we are very much obliged to the lecturer for having brought this subject before us. It is quite impossible, as has been pointed out by Captain Bacon, that he can have that experience which Captain Bacon possesses. It is equally the case that no doubt he does not know exactly, and he has not got up the question in the thorough, scientific way which a constructor might have done, but at the same time we outsiders are all looking round for a certain amount of information with regard to submarine boats. I am not aware that the information which he has given us has been disputed in any way, or that it is incorrect. I believe, as regards the main facts which he states—I do not refer to his theories or his ideas—and we can fairly well depend upon them—I think that the representations which we saw have given great pleasure to a great many people. I believe I have seen most of them before, but they certainly are a satisfaction to many people who have

come here, and who have not had an opportunity of seeing them before. I cannot myself believe that we shall have a submarine with guns, and I cannot but believe that it is impossible to have a submarine, as has been pointed out so clearly by Captain Bacon, which can compete with the torpedo destroyer in speed. Beyond a certain point it would seem to me to be quite impossible to have a submarine which can have anything like extreme speed. The balance, as he pointed out, is a very clear one. If we are to have very great speed, we cannot have equal strength or capacity in other respects, such as diving. However, I am getting, I confess, considerably out of my depth. I do not really understand at all about submarines. I am quite convinced that the Admiralty are right in keeping what they are doing as far as possible private, and keeping it secret as far as possible, and, under those circumstances, we most of us speak rather in the dark. But I repeat that I think Mr. Burgoyne has to be thanked for having brought this subject before us. It may be imperfect, it may be open to criticism, but it is undoubtedly the case that occasionally we hear in this Institution subjects brought forward in rather a crude form, and I am afraid they are only imperfectly discussed. Perhaps the lecturer himself has not always entirely mastered the subject. But there must be a limit. Everything has to have a beginning. We cannot perhaps always rise to the scientific height of those more learned societies which do not unite in them, as we do unite here, generally speaking, a certain amount of practical knowledge, and under those circumstances we have to put up with imperfections in the argument just in the same way as we have to put up with imperfections in the submarine.

Mr. J. R. Thursfield :—I should like to endorse what Sir Edmund Fremantle has said, and to express extreme gratitude to the lecturer for having brought forward this subject. I think he has done us an immense, I might almost say an incalculable, service in so doing. He has given us a great deal of pictorial and historical information, for which we feel very grateful to him. But our chief source of gratitude to him is that his lecture has been the occasion of eliciting a statement from the one person in the country who is better qualified than anyone else to deal with the question, although that statement has not been exactly favourable to the lecturer on various points, and may perhaps have been somewhat distasteful to him. We may regret that that is so, but as between the lecturer and Captain Bacon, I do not think we can hesitate to accept the authority of Captain Bacon as the higher. Yet I do wish to say that for the lucid, historical and descriptive portions of his lecture, and for having given us the opportunity, which we otherwise should not probably have had, of hearing Captain Bacon on the subject, we all of us owe the lecturer an extreme debt of gratitude.

The Chairman (Sir W. White, K.C.B., LL.D., F.R.S., late Assistant Controller and Director of Naval Construction) :—If no one else wishes to continue the discussion, I should like to make a few remarks. Mr. Burgoyne will then have the right to reply after I have spoken. We must distinguish between Mr. Burgoyne's facts and his opinions. That is true of everybody, I suppose, who expresses any opinion. I agree with Captain Bacon that the most serious defects in this paper, both in regard to criticism of past construction of submarines and to its suggestions for future construction, arise from the extremely limited knowledge of principles of construction which Mr. Burgoyne confesses to have. I

should be extremely sorry, speaking as a naval architect, that it should be supposed that I endorse his views in regard to the resistance of the water to the movement of submarines, or to the influence of form upon that resistance. Mr. Burgoyne is in the position of an amateur with a certain general knowledge, and if he will pardon me for saying so, I think that this paper might, with great advantage, have been curtailed in those parts which deal with speculative opinions of his own, not verified either by scientific investigation or by experiment, as to the motion of fluids past submarines, or of submarines through water. Then, again, Mr. Burgoyne confuses two senses in which the word "stability" must be applied to submarines. We speak of stability ordinarily in regard to ships as measuring their power of resisting inclination. A submerged vessel is the very simplest problem that one has to deal with from that point of view. A vessel wholly submerged gives exactly the same resistance to inclination in whatever direction one may attempt to incline her. She can be moved as easily longitudinally as transversely or obliquely. A vessel on the surface, as we all know, has immensely greater longitudinal stability than transverse stability. Mr. Burgoyne does not refer to that essential condition. He uses the term "stability" in quite another sense, namely, the stability of maintenance, of course. It is a very important matter in relation to submerged vessels that they should maintain their level or keep at constant depth; Captain Bacon has told us that this problem has been one of considerable difficulty in the past. His remarks rest upon large practical experience, and upon a complete acquaintance with theory, and it is interesting to hear from Captain Bacon that difficulties have been surmounted. Not so very long ago it was a very real difficulty to maintain constant depth, a difficulty leading to considerable danger in some instances. In that connection, it is important to notice that the question of speed below the surface cannot be dissociated from the risks of going to considerable depths in very short times if high speeds are attempted, if there is a departure from a level keel. Such things have happened, and I have seen it stated that Mr. Holland, the American inventor, who has given many years' work to this subject, has been particularly careful not to make experiments in deep water. There are two elements of risk which are always present to my mind: one has relation to the submarine, for which the bottom of the sea is the only place of rest; the other is in relation to balloons, which find rest only on the earth. I have had the ill-fortune to be at the bottom of deep water in a submarine, under circumstances when there seemed small chance of coming up again, and I can assure you it is not a happy or a comfortable thing. Mr. Holland is said to have been always desirous of knowing the depth of the water in the region where he was going to make experiments, and he was very wise in taking precaution. Coming back to the paper, I venture to say that when Mr. Burgoyne undertakes to deal with the phenomena of submarine navigation he should be careful in his terminology, because the word "stability" has a definite meaning in naval architecture, and he applies it in another sense. Therefore, I would suggest to him that, as he has done much in acquiring knowledge of facts and in putting information together, he should next apply himself, as he might well do, to mastering the theoretical side of this subject. It is not beyond his capacity or intelligence: it only requires a little industry. If he does this, I am confident that in his next paper he will not confuse terms as he has done here. Everything in this matter of submarine design, and, in fact, in all ship construction, depends on estimates of weight. The civil architect, as also the engineer who undertakes works of

construction upon land, has to think of strength and stability as well as cost, but he has not got to float his structures. The ship-builder, on the contrary, always has, in addition, to think: "Will this vessel float?" Now I am confident that if ever Mr. Burgoyne builds the submarine he has proposed she will go to the bottom, and no weight that can be released will ever bring her up again. That is not what he wishes, and therefore he must attack this problem from the naval architectural point of view, and must condescend to details in estimating weights. The science of the problem has to be considered carefully, in order to produce a successful submarine. Of course, there is something attractive in the idea of going below the surface, being hidden, and making attacks without being hurt; but the man who goes under water, the man who deliberately surrenders the buoyancy of the vessel in which he has embarked, takes a big risk, and cannot avoid it. A submarine when in a diving condition may be considered as a huge weight suspended by a slender thread, the margin of buoyancy represents a few gallons of water. Water-tight subdivision is mentioned in the paper as a means of safety. It might be some slight gain, but, as Captain Bacon says, a mere crevice at a moderate depth lets in large quantities of water so rapidly that there is practically no time to do anything. It is soon over, and it is a great mercy in some respects that it should be so, instead of being a lingering agony. That is the risk that has to be taken. In trying to get an advantage over the enemy the attacker takes serious risk. Many years ago a lecture was given by Mr. Nordenfelt in the old theatre of this Institution on the submarine boats bearing his name. Everybody knows that these boats were chiefly designed by Mr. Garrett, who devoted years to the subject, and did very good work. In the course of that discussion a question arose as to the action of the Turkish Government in making a difficulty about receiving the boats which Mr. Burgoyne has mentioned. I do not know where Mr. Burgoyne got his information from about the state of trepidation of the Turkish sailors. From my knowledge of Turkish sailors I doubt if they are liable to trepidation; with their views of fate and the future this is improbable. They usually face death or risk calmly. But as far as I have been informed the difficulty had nothing to do with the Turkish sailor; the fact was that those who had charge of the boat on Mr. Nordenfelt's behalf declined to go at high speed underneath water because of the risk of plunging to great depths and so coming to grief. Mr. Nordenfelt had a complete answer to the objection. He said to the Turkish officials: "I promised you that this boat should be capable of going at a certain speed below water; I will prove to you that she can attain a greater speed on the surface, and everybody knows that she is more easily driven when she is below; so that if you see her going at a higher speed on the surface I need not make the speed trial submerged." The Turk did not take that view. I may mention another thing about which, I think, Mr. Burgoyne is misinformed. I knew the Nordenfelt boat perfectly well, and I do not think she ever went at a speed approaching twenty knots. Further, I would like to say that I am quite confident Mr. Burgoyne cannot have been familiar with the circumstances of her loss. It is a matter of history that she was lost when she was proceeding up the Baltic accompanied by another boat; she was not diving. It was an unfortunate incident, but it is said to have resulted in Mr. Nordenfelt obtaining full insurance after inquiry had been made, and I believe that Mr. Nordenfelt was fully compensated for his loss. There have been many schemes for applying the submarine principle to ordinary navigation. I have heard people speaking glibly about the time when there will be

vessels on the Trans-Atlantic service many thousands of tons in displacement which can travel wholly below water, the passengers comfortably existing below the troubled surface waves which so often disturb their equanimity in ordinary ships, and occasionally coming up to a superstructure carried by this hidden hull, and there get in light and air. Well, those are dreams. I do not say that they are impossibilities, but I do not think they are likely to becomé actualities very soon, or that the time is likely to come when passengers will be prepared to forfeit the light and air of heaven and go below the water in order to escape surface disturbances. I hope I have not said anything unkind. I have not intended to do so. My advice, which I would repeat to Mr. Burgoyne, is that he should let his undoubted interest in this subject and his large acquaintance with it carry him on to the point of qualifying himself to deal with it completely, as he might do quite readily with the help of a naval architect. He would then understand the ground upon which all designs must be based, and in that case I am certain that he will not entertain some of the projects for the future of which he now thinks so well.

Mr A. H. Burgoyne, in reply, said: — At the present time, after the crushing results of this argument, I feel somewhat like the Russians in Port Arthur, but with this difference, that whereas the Russians do feel somewhat crushed, I feel immensely delighted. For many years I have been trying to get Captain Bacon to talk or write something about the subject, but I have never been able to move him, and I think this meeting from my point of view has been an infinitely greater success than I ever suspected it possibly could be. Captain Bacon forgets this very important thing: that I distinctly stated I was speaking of the future, not of the past, and he also forgets that I was referring, in my remarks on the various appliances I mentioned, to the large submersible of the future, and not to the little instruments with which he is experimenting down at Portsmouth at the present time. He also taunts me with my lack of technical terms. I am not a well-trained naval officer, such as he is, hence I cannot be expected to know the technical terms to which he refers. I pleaded ignorance in my paper, and I think that pleading should have been sufficient for my lack of knowledge on that minor point. I have admitted that my knowledge was very meagre, and I made the obvious excuse that I knew nothing about naval construction. He made some remark about the position of the conning tower in my design of the "Holland" boat. Well, it was not my design at all. I took it out of "Brassey's Annual"! Then with regard to my statement that a vessel of 500 tons could have a reserve buoyancy of 40 tons, Captain Bacon says one ton would be the outside. I was thinking, however, of surface buoyancy. Still, I was very glad to hear it. That is the very knowledge I wanted. Next, with reference to speed, Captain Bacon pointed out that the extreme speed of our best destroyers at the present time was only 25 knots. I believe the destroyer "Viper" did something under 38, and the "Arrow," in America, 42·8 knots: and when I referred to large submersibles being capable of doing 26 to 30 knots, I referred to trial speeds obviously. Truly, as to the majority of our destroyers, we get a cruising speed of about 25 knots only, until you arrive at the higher speed class of the present day, when it has been 30 or over. Then, with regard to vulnerability to torpedo attack, he says you should keep your vessel small. Quite right. We started small with the torpedo-boats with a similar idea in view, but they got larger and larger. He quoted several things, and he said they were

matters I should have put in detail before the audience. I think you can thank your stars that I did not put those matters before you. You would have been here until Christmas if I had attempted to detail even one of them. Perhaps it may be as well, just at present, not to enter into the question of raising boats to the surface, so I will pass that by. Mr. Barnaby referred to the fact that the thing to seek for was a single engine which would do for both surface and submerged propulsion. It will interest him to know that there is such an engine—an oil engine—being placed in the "Glauco," now building at Venice, designed by Cæsar Laurenti. The engine was spoken of to me by Signor Laurenti, the constructor, out there, and this engine is to be used for both surface and submerged work. I thank you for your attendance here, and for your kind attention to my paper and remarks.

The CHAIRMAN:—Before the meeting breaks up I should like to say that we formally record our thanks to Mr. Burgoyne for the trouble he has taken, and for the interesting information he has brought before us here.

Commander W. F. CABORNE, C.B., R.N.R.:—Before we disperse, as a member of the Council of the Institution, I will ask you to record a very hearty vote of thanks to Sir William White for his kindness in coming here to preside this afternoon, and also for the very lucid and valuable remarks he has made upon the paper.

NAVAL NOTES.

HOME.—The following are the principal appointments which have been made: Captains—R. S. Phipps Hornby to "Diana"; D. Beatty, D.S.O., to "Suffolk"; J. L. Marx, M.V.O., to "Mars"; A. J. Henniker-Hughan to "Venerable"; E. G. Shortland to "Hogue"; H. R. Robinson to "Phœbe"; E. Lees to "Thames," as Inspecting Captain of Submarines; R. H. J. Stewart to "Sutlej." Commander — J. E. Drummond to "Tauranga."

Vice-Admiral Sir A. L. Douglas, K.C.B., hoisted his flag on Thursday, 20th ult., at Portsmouth as Commander-in-Chief, in succession to Admiral Sir J. Fisher, G.C.B., who assumed his duties as First Sea Lord on the following day. Rear-Admiral E. S. Poë, C.V.O., hoisted his flag on board the "Good Hope" at Portsmouth on the 3rd inst., in Command of the Cruiser Squadron, in succession to Rear-Admiral Sir W. H. Fawkes, K.C.V.O.

Vice-Admiral Sir G. Noel, K.C.B., K.C.M.G., arrived at Singapore in his flag-ship, the "Glory," on the 2nd inst., for a conference with Vice-Admiral A. D. Fanshawe, Commander-in-Chief in Australia, and Rear-Admiral G. L. Atkinson-Willes, Commander-in-Chief in the East Indies. Vice-Admiral Fanshawe arrived at Singapore in his flag-ship, the "Eurylus," on the 2nd inst., a few hours after the arrival of the "Glory," and Rear-Admiral Atkinson-Willes, in the "Hyacinth," arrived on the 6th inst., from Trincomalee.

The first-class armoured cruiser "Hogue" commissioned at Devonport on the 27th ult. for service on the China station, where she will relieve a sister-ship, the "Cressy." The first-class armoured cruiser "Sutlej" was commissioned at Chatham on the 29th ult. under sudden orders from the Admiralty, and joined the Home Fleet on the 2nd inst. at Portland.

The first-class cruiser "Terrible" arrived at Portsmouth on the 20th ult. with the relieved crew of the first-class battle-ship "Albion"; she was to have taken out relief crews for some of the smaller vessels on the China station, but those orders have been cancelled, and the ship is to be paid off.

The second-class cruiser "Eclipse" arrived at Spithead on the 7th inst. from China, and will pay off at Portsmouth. The second-class cruiser "Hermione" commissioned at Devonport on the 11th ult., and will convey a new crew to Bombay for her sister-ship, the "Fox," which is to recommission for a further term of service on the station; the relieved crew of the "Fox" will return to England in the "Hermione," which left on the 21st ult. for her destination. The second-class cruiser "Diana" left Plymouth on the 13th ult. for the Mediterranean.

It had been intended to send new crews out in the "Terrible" for the sloops "Vestal," "Rinaldo," and "Espiegle," the despatch-vessel "Alacrity," and the gun-boat "Tweed"; but it has now been decided to withdraw the three sloops from the station without relieving them. The

"Tweed" will be paid off into the Reserve at Hong Kong, and a new crew will be sent out to the "Alacrity," probably by a merchant steamer. The third-class cruiser "Pearl" is also to be withdrawn from the Cape station without relief.

The cruise round Scotland of the Home Fleet was cut short in consequence of the Russian outrage on the fishing fleet in the North Sea, and it has returned to Portland, where it has been joined by the destroyer flotillas and the Cruiser Squadron. The cruise of the Mediterranean Fleet in the Adriatic was also, for the same reason, summarily brought to an end, and one division, with the large cruisers, sent to Gibraltar in connection with the movements of the Russian Fleet; the cruisers, with those of the Channel Fleet, were under Rear-Admiral Sir B. Walker, Bart., and were employed in watching the movements of the Russian ships from Vigo to Tangier.

Launch of Two Scouts.—The new scouts "Foresight" and "Patrol" were launched on the 8th ult. from the Fairfield Shipbuilding Yard, Govan, and on the 12th ult. from Messrs. Laird's Yard, Birkenhead, respectively. The dimensions of the "Foresight" are as follows:—Length, 365 feet; beam, 39 feet 2 inches; draught, 14 feet 1 inch, on a displacement of 2,800 tons. The engines are to develop 16,500-I.H.P., to give a speed of 25 knots; the coal capacity will be 150 tons (normal), 380 tons (possible), giving a radius of action of 3,000 miles at 10 knots. The armament will consist of ten 12-pounder Q.F. guns, eight 3-pounders, and two submerged torpedo-tubes. The dimensions of the "Patrol" are as follows:—Length, 370 feet; beam, 38 feet 9 inches; draught 13 feet 9 inches, on a displacement of 2,850 tons. In other details she is the same as the "Foresight."

Report on Naval Boilers.—The committee which was appointed by the Admiralty, in September, 1900, to consider certain questions respecting modern types of boilers for naval purposes, having completed their investigations and experimental trials, and being in a position to recommend standard types of boiler for use in our Navy, have now issued their final report [Cd. 2207]. In his covering letter to the Secretary of the Admiralty, dated from the "Bulwark" at Rapallo, June 12th, 1904, Sir Compton Domvile, the President of the Committee, and now Commander-in-Chief in the Mediterranean, after dwelling upon the great care and pains taken to obtain correct results and his high opinion of the work done by his colleagues, remarks:—

"With reference to our previous report, I am compelled to say that my experience with the Belleville boilers on the Mediterranean Station has been very favourable to them as a steam generator, and it is clear to me that the earlier boilers of this description were badly constructed and badly used. We have had no serious boiler defects in any of the ships out here, and the fact that two ships are about to be recommissioned with only the ordinary annual repairs being undertaken shows that their life is not so short as I originally supposed. However, the second commission of these ships will be a very good test of the staying capabilities of their boilers."

The Committee have, including the present one, made ten reports, the more important being an interim report made in February, 1901, and a progress report made in the spring of 1902; the others being mainly reports of special trials, appendices, and minutes of evidence. The Committee are unanimous in their report, which is

signed by the following members :—Admiral Sir Compton Domvile, president; Mr. James Bain, R.N.R., superintending engineer Cunard Line; Mr. John Inglis, of the firm of Messrs. J. and A. Inglis, engineers and shipbuilders; Professor A. B. W. Kennedy; Mr. John List, R.N.R., superintending engineer Castle Line; Mr. J. T. Milton, chief engineer of Lloyd's Register of Shipping; and Engineer Rear-Admiral J. A. Smith; with Engineer Lieutenant W. H. Wood, R.N., secretary.

The Committee begin by supplying a detailed list of the work already accomplished and a summary of the principal points in the previous reports. Thus they say that :—

"The report of May, 1902, was intended to be final as regards the Belleville boiler, and the Committee have since seen no reason to modify the opinion expressed in paragraph 6 of that report—viz., that it is 'undesirable to fit any more of this type in His Majesty's Navy.'"

They refer again to their report of May, 1902, in which it was stated that :—

"Experience had confirmed them in the opinion that 'the advantages of water-tube boilers for naval purposes are so great, chiefly from a military point of view, that, provided a satisfactory type of water-tube boiler be adopted, it would be more suitable for use in His Majesty's Navy than the cylindrical type of boiler.'"

And with reference to their already expressed view that the four types of boiler, Babcock and Wilcox, Niclausse, Dürr, and the Yarrow large tube, were sufficiently promising to justify their use in the Navy in combination with cylindrical boilers, they add that :—

"They are now satisfied that two of these four types—viz., the Babcock and Wilcox, similar to that tried in the 'Hermes,' and the Yarrow large tube, similar to that tried in the 'Medea,' are satisfactory, and are suitable for use in battle-ships and cruisers without cylindrical boilers. In the Babcock and Wilcox boiler the generating tubes are nearly horizontal; in the Yarrow boiler they are nearly vertical. Each type has its particular advantages, and only long experience on general service can show which is on the whole the better boiler. For the present the Committee unanimously recommend both types as suitable for naval requirements."

The report then proceeds :—

"Although the Committee have no knowledge of any type of water-tube boiler which is likely to prove more suitable for His Majesty's ships than the two recommended, there are other types which may be considered worthy of trial later on. If any type of boiler is considered in future to be of sufficient merit to justify its trial in the Navy, it is recommended that it be fitted in a new vessel not smaller than a second-class cruiser."

The Committee do not offer any remarks on the most suitable type of boiler for small vessels of high speed, but they say that :—

"From the nature of the case, some form of 'express' boiler with small tubes closely pitched is absolutely necessary in order to obtain such a ratio of output to weight of boiler as is required in torpedo-boats and destroyers. For small cruisers, however, which have to keep the sea and act with the Fleet, it is probable that a boiler such as the Yarrow large-tube would, on the whole, give better results than the 'express' types which have hitherto been fitted."

The principal comparative results on which the recommendations of the Committee are based are set forth under the following heads :—Thermal efficiency of boilers, wetness of steam, loss of water, examination and cleaning of interiors of tubes, external cleaning of tubes, bending of tubes, corrosion of tubes and wear of casings and up-takes, liability to

damage from being forced, skilled firing required, superheated steam, feeding of the boilers, salt water, and relative weights. From among the detailed and necessarily technical statements on these points the following appear to possess special interest :—

"A noticeable feature in connection with the boiler efficiencies is the improvement in the results obtained with the later boilers of the Babcock and Wilcox type. The earliest of these, fitted in the 'Sheldrake' in 1898, showed efficiencies ranging from 66·0 per cent. to 59·2 per cent.; the boilers fitted in the 'Espiegle' in 1901 showed improved efficiencies ranging from 73·2 per cent. to 63·1 per cent. Those of the 'Hermes,' fitted in 1903, show a still further gain in economy, the efficiencies ranging from 75·8 per cent. to 66·3 per cent., and the same boilers, after modification, showed, on one occasion, the high efficiency of 81 per cent.

"Of the boilers tried by the Committee, the Yarrow boiler can be internally examined and cleaned in the shortest time and with the least amount of labour—to obtain access for such an examination and cleaning it is only necessary to remove three manhole doors.

"The makers of the Dürr boilers stated that not more than 35 lbs. of coal should be burnt per square foot of fire-grate per hour in the 'Medusa.' The Committee consider that this limitation of the quantity of coal to be burnt was prudent, as the over-heating and bending of tubes in one of the boilers during the full-power homeward run from Gibraltar were, in the opinion of the Committee, due to the fact that the safe limit had been exceeded. It is also considered that the limitation of the amount of coal to be burnt per square foot of grate applies with even greater force to the Niclausse boiler, as the supply of water to the tubes is freer in the case of the Dürr boiler than in that of the Niclausse. As the result of their trials, the Committee find that the Yarrow boiler can be severely forced without danger, and that the Babcock and Wilcox boiler can with safety be forced to the extent shown in the reports.

"The satisfactory stoking of water-tube boilers requires a higher degree of skill than that of cylindrical boilers, and this is more necessary with the large grates of the Dürr, Niclausse, and Babcock and Wilcox boilers than with the smaller grates and better shape of combustion chamber of the Yarrow. The stoking in the 'Medea,' 'Medusa,' and 'Hermes' was good throughout the trials, and towards the end was excellent. Under ordinary service conditions, such good firing can hardly be expected, at least until a vessel has been some time in commission. Good results can, however, be obtained with the Yarrow boilers with engine-room complements new to the ship, as shown by the trials to Malta and back which have been made by the 'Medea' since the completion of the Committee's trials with that vessel.

"The report on the trials of the 'Medea' and 'Medusa' contains a description of experiments made on the Yarrow and Dürr boilers in regard to their behaviour when working with brackish water. These experiments, so far as they went, indicated that neither type of boiler was likely to give trouble from this cause. In the case of the Yarrow boiler, this result has been corroborated by the fact that on a recent voyage the 'Medea' is reported to have had leaky condenser tubes and a corresponding density in the boilers without any bad effect."

In conclusion, the Committee refer to their obligation to Mr. C. J. Wilson, F.C.S., who has, during the four years of their work, given his valuable personal attention to the analysis of funnel gases and of coal samples without any remuneration; to Messrs. Thomas Wilson, Sons, and Co., for permission to examine the boilers of the steamship "Martello";

and to Mr. W. S. Hide, the superintending engineer of that company, for affording the Committee facilities for carrying out the inspections and giving information concerning the results obtained in the running of that vessel.—*The Times* and *Naval and Military Record.*

FRANCE.—The following appointment has been made: Capitaine de Vaisseau—R. Duval to "Montcalm."—*Journal Officiel de la République française.*

The following vessels will be commissioned and paid off during the current quarter:—

At Cherbourg—The coast-defence battle-ship "Furieux," at conclusion of her trials, will be placed in the ordinary Reserve. The aviso "Rance" is to be commissioned to relieve the "Nièvre" in the East Indian Naval Division.

At Lorient—The third-class cruiser "Lavoisier," senior officer's ship for the Newfoundland Fisheries, will be paid off and placed in the ordinary Reserve for the winter.

At Toulon—The new first-class armoured cruiser "Dupetit Thouars" will commission for her trials; the gunnery training-ship "Couronne" will commission for trials after receiving new boilers; the second-class cruiser "Pascal" will be placed in the special Reserve on her return from service in China.

The ships of the Squadron of the North, with the exception of the destroyers, were placed on the 1st October on the usual reduced scale of complements for the winter months.

The New First-class Armoured Cruiser "Edgard Quinet."—It has now been decided that this new cruiser, which appeared in the Estimates for this year as "C 16," is to be laid down at Brest. She is to be of an improved "Ernest Renan" type, and will be the largest cruiser as yet built for the French Navy. Her dimensions will be as follows:—Length, 528 feet; beam, 69 feet 4 inches; displacement, 14,300 tons; with a draught of water of 26 feet 6 inches. Protection will be afforded by a complete water-line belt of hard steel, 6·7 inches thick amidships, tapering to 3·6 inches at the extremities, with a depth of 7 feet 6 inches; above this belt is another, reaching to main deck, but carried up to the upper deck at the bow, 5 inches thick, tapering to 2·2 inches at the bow and stern. The armour on the main turrets will be 8 inches, with 5-inch ammunition hoists; on the turrets for the secondary armament 5·5 inches, and on the casemates 4·7 inches. A cofferdam filled with cellulose will run round the ship to a height of 16 feet above the water-line, and there will be an after transverse bulkhead 6 inches thick. There will be two armoured decks, the lower 2·4-inch, and the upper 1·3-inch. The armament will consist of two 24-cm. (9·4-inch) 50-calibre guns (1902 Model) in turrets, one forward and one aft; sixteen 164·7-mm. (6·4-inch), Q.F. 50-calibre guns, twelve in pairs in the upper deck turrets, (of which there will be three on each broadside), and four in the main deck casemates; eight 6-pounder Q.F., and sixteen 3-pounder Q.F. guns, with 5 torpedo-tubes, two submerged. The ship will have three sets of main engines, which are to develop 40,000-I.H.P., and give a speed of 24 knots. The ordinary coal stowage will be 1,500 tons, but the ship will be able to carry, when necessary, 2,400 tons, which will give a radius of action of 7,000 and 12,000 miles at 10 knots speed respectively, and 1,100 and 1,700 miles at full speed. It is not yet known with what boilers she will be fitted.

The following comparative table of recently constructed cruisers may be of interest :—

Name and Nationality.	Length.	Displacement.	I.H.P.	Speed.	Armament.
		Tons.		Knots.	
Drake (English)	529 feet 6 inches.	14,100	30,000	23	Two 9·2-inch; sixteen 6-inch; fourteen 12- and four 3-pounders.
Black Prince „	480 feet.	13,500	23,500	22·5	Six 9·2 inch; ten 6-inch and twenty 3-pounders.
California (United States)	502 feet.	13,400	23,000	22	Four 8-inch; fourteen 6-inch; eighteen 14- and twelve 3-pounders.
Tennessee „	504 feet 6 inches.	16,000	25,000	22	Four 10-inch; sixteen 6-inch; twenty-two 1·4-inch and twelve 3-pounders.
Edgard-Quinet (French)	528 feet.	14,300	40,000	24	Two 9·4-inch; sixteen 6·4-inch; eight 6- and sixteen 3-pounders.
Léon-Gambetta (French)	482 feet.	12,550	27,500	22	Four 7·6-inch; sixteen 6·4-inch; twenty-two 3-pdrs.

The Extra-Parliamentary Commission on the Navy.—The extra-parliamentary commission on the Navy visited the principal naval ports on the following dates :—Cherbourg, 20th to 22nd September; Brest, 23rd to 25th September; Toulon, 1st to 5th October.

Vice-Admiral Touchard, Commander-in-Chief and *préfet maritime* of Cherbourg, gave evidence before the Commission, and spoke highly of the submersible "Aigrette." There are no vessels now building at Cherbourg, and the "Jules Ferry" is the only important vessel being completed. As regards vessels in the 2nd Category of the Reserve the admiral stated that the coast-defence battle-ships "Jemmapes," "Valmy," and "Furieux" are ready for sea, and that the cruiser "Chasseloup-Laubat" will also soon be ready. The armoured gun-boats "Flamme" and "Grenade," will be complete by the dates prearranged. The cruiser "Friant," is not available, her boilers have to be changed, and no money is yet voted in the Estimates for the purpose. The coast-defence battle-ship "Vengeur," at present used for reserve purposes, is a vessel still capable of efficient service, and could be got ready at a cost of 80,000 francs (£3,200), but no orders to this effect have as yet been given.

The admiral considers the *personnel* insufficient chiefly as regards mechanics and engineer officers.

In the afternoon the Commission visited the submarines "Sirène," "Narval," "Aigrette," and "Z," and appear to be in favour of the submersible type "Aigrette," with a certain number of submarines proper for the *défense-mobile* of the ports. They are also of opinion that there is no necessity for experimenting with other types, as the present submarine vessels are sufficiently perfect.

In the evening the Commission heard evidence regarding the state of discipline in the Navy, which some witnesses said was most unsatisfactory, instancing the case of the "Dupleix," which left 42 men behind when ordered to se who were simply amusing themselves in the town.

It is stated that the recruits now drawn from the manufacturing towns do not show the same spirit of subordination as those from the coast districts.

As regards the defences of Cherbourg, the admiral said that if a squadron found itself in the roads on the declaration of war, it would be necessary for it to leave at once if it wished to avoid being sunk at anchor. The defence works are perfect, but the batteries are undermanned.

The Commission continued its inquiry next day, and examined all the heads of departments of the arsenal. As regards new constructions, the only vessel giving employment is the "Jules Ferry," which is being completed afloat; the workmen employed number 3,615, but on account of slackness of work it will be necessary to discharge a large number of these at the end of the year.

The artillery and the question of mounting guns in pairs in turrets was a long time under discussion; Vice-Admiral Touchard and the Gunnery Department are in favour of the present system, though orders are stated to have been recently issued in the opposite direction. As regards the manning of the land fortifications, the opinion was expressed that coast batteries and sea forts should be handed over to the Navy.

In the afternoon the Commission went on board the battle-ship "Masséna," flag-ship, Vice-Admiral Caillard, Commanding the Northern Squadron.

The admiral spoke about the state of discipline in the Navy, and said that officers were discouraged at the situation created between them and the men they are called upon to command—the men's demands, whether justifiable or not, are always well received, and they are becoming wanting in respect for their superiors.

The admiral also said that there was a scarcity of special gunnery and engine-room ratings, and at general quarters all the guns cannot be manned at once.

The Commission left Cherbourg for Brest on 22nd September, on board the first-class cruiser "Amiral Aube," at 7 a.m., and were due to arrive there at 6 p.m., accomplishing the distance of 210 miles at a speed of a little over 19 knots.

Cruisers and Submarines.—A combined exercise between the cruisers of the Northern Squadron and submarines took place on 23rd September off Cherbourg. The idea of the exercise was for the submarines to stop the cruisers forcing their way through the fairways to the roadstead.

The armoured cruisers "Gloire" and "Condé" and the destroyer "Forbin" weighed, going out by the western fairway, while the submarines took up positions near the fairways, and the "Narval" dived a mile to the westward of Cape Lévi. The cruisers made two different attempts to force the entrances east and west, and each time they were torpedoed. This experiment, which took place about 5 p.m., was particularly interesting to the cruisers, who, new to the squadron, had never before taken part in manœuvres of submarine attack.—*Le Temps, Le Yacht,* and *L'Armée et Marine.*

GERMANY.—The following are the principal promotions and appointments which have been made: Vice-Admiral—Fischel to Command of Second Squadron of Active Fleet. Rear-Admirals—Graf von Baudissin to Command of First Squadron of Active Fleet; Breusing to be Second-in-Command of Second Squadron of Active Fleet; Graf von Moltke to be Second-in-Command of Cruiser Squadron. Kapitäns zur See—Gülich and Graf von Moltke to be Rear-Admirals; Ingenohl to "Hohenzollern"; Sommerwerck to "Blücher"; Grapow to "Wörth"; Franz to Inspector of

Coast Artillery and Submarine Mines; Ehrlich to "Braunschweig"; Pohl to "Elsass"; Paschen to "Mecklenburg"; Rollmann to "Kaiser Wilhelm der Grosse"; Kalau von Hofe to be Chief of the Staff of the North Sea station; Wentzell to be Chief of the Staff of the Baltic station; Zanke to "Zähringen"; Scheibel to "Wettin"; Gühler to "Kaiser Karl der Grosse"; Rampold to "Prinz Heinrich"; Schack to "Weissenburg."—*Marine Verordnungsblatt.*

Reorganisation of Active Fleet.—The Active Fleet was reconstituted on the 1st October. Admiral von Koester, who, in addition to being in supreme command of the fleet, also commanded the First Squadron, has been relieved of the latter duty, Rear-Admiral Graf von Baudissin being appointed to the command of the squadron, and Vice-Admiral Fischel being appointed to the command of the Second Squadron, which is now composed of first-class battle-ships, which have replaced the small fourth-class battle-ships, which up to now have formed it. The Commander-in-Chief flies his flag on board the "Kaiser Wilhelm II."; Vice-Admiral Fischel on board the "Kaiser Friedrich III."; Rear-Admiral Graf von Baudissin on board the "Wittelsbach"; Rear-Admiral Breusing, Second-in-Command of the Second Squadron, on board the "Braunschweig"; and Rear-Admiral Schmidt, Commanding the Cruiser Division, on board the first-class armoured-cruiser "Friedrich Carl."

First Squadron. First Division.

First-class battle-ships.—"Wittelsbach," "Zähringen," "Wettin."

Second Division.

First-class battle-ships.—"Mecklenburg," "Kaiser Karl der Grosse," "Kaiser Wilhelm II."

Despatch-vessel.—Third-class cruiser "Blitz."

Second Squadron. First Division.

First-class battle-ships.—"Kaiser Friedrich III.," "Kaiser Wilhelm der Grosse," "Wörth."

Second Division.

First-class battle-ships.—"Braunschweig," "Elsass," "Weissenburg."

Despatch-vessel.—"Pfeil."

Cruiser Division.

First-class armoured cruiser.—"Friedrich Carl."

Third-class cruisers.—"Arcona," "Hamburg," "Frauenlob." This sub-division is attached to the First Squadron.

First-class armoured cruiser.—"Prinz Heinrich."

Third-class cruisers.—"Ariadne," "Medusa," "Amazone." This sub-division is attached to the Second Squadron.

The fleet therefore, now consists of 12 first-class battle-ships, 2 first-class armoured cruisers, 6 third-class cruisers, and 2 despatch-vessels.

The battle-ships of the Fleet commenced, on the 1st October, the training of the new crews, which have taken the place of the time-expired men, who are always discharged each year after the manœuvres at the end of September. The Cruiser Division will be in the hands of the dock-yards for repairs up to the middle of this month.

New Reserve Squadron.—An Imperial Decree, dated the 29th September last, directs that with the removal of the Coast-Defence battle-ships from the Active Fleet, all the vessels of this class are to form a Reserve Squadron. Two of these ships

are to be commissioned as Depôt-ships for the Squadron, the remaining six being in the First-class Reserve. The ships are to be placed under the orders of the "Ships Artillery Inspection," and the two Depôt-ships, besides being used for training purposes, are also to be used for gunnery and torpedo experiments.

New Ships and Dockyard Notes.—The new first-class battle-ship "Braunschweig," having been completed at the Germania Yard, Kiel, where she was built, the ship has been handed over to the Naval authorities at Kiel and was commissioned for her trials on the 15th ult.; her sister-ship, the "Elsass," built by the Schichau firm, at Danzig, arrived at Kiel on the 26th ult., and has also been commissioned for her trials. The two first-class battle-ships "Wörth" and "Weissenburg," which have been undergoing a thorough repair, and bringing up-to-date during the last two years at Wilhemshaven, are now ready for commissioning, and all four above-mentioned vessels are to join, as soon as ready, the Second Squadron of the Active Fleet.

The beginning of October sees 17 war-ships in course of completion and on the stocks in German yards, viz., 8 battle-ships, 3 armoured cruisers, and 6 third-class cruisers. Several of these vessels are so far advanced that they are almost ready for their trials, indeed, the first-class battle-ships "Elsass" and "Braunschweig," as we have already reported, have been commissioned for them, and the small cruisers "Lübeck" and "München" will be similarly commissioned during the next few weeks, the "Berlin" having already completed hers. The "Elsass" and "Braunschweig" are the last two ships of the 1901 programme to be completed; the "Berlin" forms one of the 1902 programme, while the "Lübeck" and "München" are the first vessels of the 1903 programme to be finished, the new first-class battle-ship "N," building at the Germania Yard, and not yet launched, also belongs to the 1903 programme, her sister-ship, the "Lothringen," building at Danzig, having been launched on the 27th of last May. Other battle-ships completing are the "Preussen" and "Hessen," which have been built at the Vulcan Yard, Stettin, and the Germania Yard, Kiel, respectively; while the armoured cruisers "Roon," one of the ships of the 1902 programme, built at the Imperial Dockyard, Kiel, is well advanced, and should be ready for her trials in the spring, and good progress is being made with a sister-ship, the "York," under construction at the Yard of Blohm and Voss, Hamburg. Of this year's programme, the two new battle-ships "O" and "P," have both been laid down, at the Schichau Yard, Danzig, and the Weser Yard, at Bremen, respectively, as has also the new armoured cruiser "C" at the Imperial Dockyard, Kiel, and the third-class cruiser "N," at the Weser Yard, Bremen, while a second vessel of this class is also to be laid down. It is worthy of note that new German ships are completed up to their programme dates, with a regularity which will be found in the dockyards of no other country. Three years is allowed from the laying down of a battle-ship to its completion and this period is not exceeded.

Up to the present it has been customary to haul the smaller torpedo-boats up on slips for repairs, etc., while the larger ones have been taken into dock for this purpose, but as only what are practically destroyers are now built for the Navy, it is no longer possible to haul them up on slips, while to put them into the large docks is very uneconomical. The Imperial Dockyard at Wilhelmshaven is already provided with a floating dock, specially built for torpedo-boats, and on the 24th September last, a similar dock for the repair of torpedo-boats was launched at Kiel. The dock is built

of steel, is 250 feet long, and has a lifting capacity of 800 tons, and is fitted with electric lights, and all the latest appliances.

The New Gunnery School at Sonderburg.—The works at Sonderburg, on the Alsen Sound, which is to be the new station for the gunnery training-ships and school, have been taken in hand. For the station a stretch of the shore, 1,100 yards in length, has been secured; on the sea face of this a stone jetty 800 yards long will be constructed, with five landing stages fitted with the necessary bollards, etc. The mooring places of the ships and boats will be connected with the shore by long gangways. In rear of the mole it is proposed to construct three terraces, on the centre one of which will be erected the necessary school buildings to accommodate 100 cadets; later on barracks for the men will be built on the upper terrace, but for the present only the necessary temporary quarters will be put up, although there is no doubt that there will be before long a large development of this new station. As soon as possible the gunnery-ships, now lying at Kiel, will be transferred to Sonderburg, only returning to Kiel for the necessary repairs. The naval authorities have been in communication with the Municipal Council of Sonderburg, where the necessary accommodation for the married officers and warrant officers will be found, a new road being constructed to connect the town with the station.

Prize-Firing and Marksmanship in the Navy. A New Kaiser Challenge Cup. — The Kaiser has given a new proof of his continuous interest in the shooting of the Fleet by offering a second silver cup for competition in heavy gun target practice to the Active Fleet. Ten years ago His Majesty presented his first challenge cup which is competed for each year by the ships of the First Squadron. In 1894 and 1895 the "Sachsen" held it; in 1896 it went to the "Wörth"; in 1897 to the "König Wilhelm"; in 1898 to the "Weissenburg," and in 1899 to the "Kurfürst Friedrich Wilhelm." In 1900 and 1901 it was not competed for, but in 1902 it was won by the "Kaiser Friedrich III.," and last year by the "Wittelsbach." The new trophy is to be competed for by the ships of the newly constituted Second Squadron of the Active Fleet and the two armoured cruisers of the Cruiser Division, while the first cup remains as before with the First Squadron. Three years ago the Kaiser presented a gold challenge cup to be competed for by the Cruiser Squadron; this was won in 1901 by the "Fürst Bismarck"; in 1902 by the "Thetis," and again in 1903 by the "Fürst Bismarck."

It was only last year that the German Admiralty, with the view of increasing the standard of marksmanship in the Fleet, and at the same time providing a reserve of well-trained seamen-gunners, inaugurated a system of increased pay to seamen, who, after receiving a special training in gunnery, re-engage at the end of their three years' compulsory service for a similar period. These men will be known as *Schützenkapitulanten*, will serve on board the vessels of the Active Fleet, and will receive 200 marks (£10) in addition to the pay ordinarily received by seamen who re-engage (*Kapitulanten*). This bonus will be treated as deferred pay, and handed to the men when they obtain their discharge. The *Schützenkapitulanten* will be allowed three months' leave on full pay, which they may take either at the beginning or end of their term of service. Men who show special aptitude will be given facilities for continuing their career in the Navy as petty officers.—*Marine Rundschau* and *Neue Preussische Kreuz-Zeitung.*

UNITED STATES. — *Report on Naval Gun Factory.* — The report of the Board of Navy officers appointed to consider the enlargement of the Gun Factory plant at the Washington Navy Yard, has been received by the Secretary of the Navy, meets with his approval, and also received the unqualified endorsement of Rear-Admiral Charles O'Neil, late Chief of the Bureau of Ordnance, before vacating his appointment. In all respects this report is most valuable, and will probably be adopted in the main by the Secretary of the Navy, in the plans of the Navy Department for the enlargement of the Gun Factory.

The Board consisted of Captain William M. Folger, Commander J. M. Bowyer, and Lieut.-Commander F. F. Fletcher. The Board made a careful investigation of the annual output of the Gun Factory, which it found deficient for the needs of the Navy. In remarking on this point the Board said in its report :—

"During the last six years Congress has made appropriations for 15 battle-ships and 4 monitors, 8 armoured cruisers, and 9 protected cruisers. This is equivalent, in battery power, to an average of a little more than 3 battle-ships per year. Comparing the number of guns required for the above ships with the productive capacity of the Gun Factory, the following results are shown :—

Calibre of Guns - - -	12-in.	8-in.	6-in.	3-in.
Appropriation in six years -	76	200	354	554
Productive capacity in six years	48	96	180	360
Deficiency of output in six years	28	104	174	194
Percentage short - - -	88	100	96	54

The productive capacity of the Gun Factory working double time, or sixteen hours a day, is thus seen to be from 54 per cent. to 100 per cent. short of the demands made upon it by the average yearly appropriation of Congress. Working eight hours per day the above percentage would be nearly doubled, and working the full twenty-four hours per day will still be from 20 to 25 per cent. too small."

The general conclusions of the Board are as follows :—

"1. The normal output should be by one shift of men working as prescribed, eight hours.

2. It is observed, during the period of active reconstruction of the Navy comprised within the past six years, that Congress has appropriated funds for building four large vessels per annum, or their equivalent in large vessel and cruisers. It is assumed by the Board in its recommendations that this may continue to be the rate of construction authorised for the immediate future, and on this assumption it is believed that the machinery plant should be of an annual capacity, at eight hours labour, to permit the completion from forgings procured from private manufacturers, of all guns of calibres from 12-inch to 6-inch inclusive, required for four large vessels of war, battle-ships or first-class cruisers

4. The forging plant should be increased to a capacity to permit the production from billets or ingots purchased from private industry, of forgings of sizes applicable to what is known as the "secondary battery" calibres, in annual quantity to be equal to 50 per cent. of the requirements for four vessels of war of large size, battle-ships or first-class cruisers.

5. The foundry plant to be of a capacity (including products of steel as well as brass) to permit the casting of small objects which would profitably replace such material now made of brass, and at the same time

utilise the scrap product of the factory, at present disposed of disadvantageously by public sale. The Board is of the opinion that the present practice at the factory of placing all orders for large castings for mounts with private parties is a wise one, there being ample competition for the protection of the Government.

6. There should be provided such additions to the power capacity as will most efficiently meet the demands of the increased manufacturing plant above described.

7. The Board is of the opinion that the United States should acquire about twelve acres additional territory contiguous to the present limits of the yard.

8. The Board recognises that this development of the Gun Factory cannot be undertaken at this time or with funds provided by a single appropriation by Congress, but recommends that such ultimate expansion be adopted in principle."

In commenting upon the report of the Board, Rear-Admiral O'Neil, Chief of the Bureau of Ordnance, remarked :—

"It is quite evident from this report that the present facilities of the Naval Gun Factory are quite inadequate for carrying on current work, and that in order to complete the armament of vessels already authorised by the time they will be required and to provide for the probable future needs of the Navy, a considerable expansion of the gun plant at the Washington Navy Yard will be necessary. This Bureau believes that in general, it is preferable for the Government itself to manufacture the guns and their accessories for the Navy, as not only is the product more satisfactory than if procured by contract, but the fact that the time of completion is under better control when the work is performed in the Government shops is a matter of great importance. When work of such a character is given out by contract, there is no certainty as to when it will be completed, nevertheless, the force of circumstances has obliged the Bureau to contract for sixty guns of medium calibre, and the mounts therefor, to supplement the product of the Naval Gun Factory, but this alone will not suffice to procure within the proper limit of time the armament for several of the vessels now under construction. There are but few private establishments in this country which are properly equipped to execute the class of work that is performed at the Naval Gun Factory, and the best, and in fact the only practicable means for supplying the vessels now under construction with their armament, by the time it is needed, is to make an immediate and substantial increase to the facilities of the Naval Gun Factory.

The Bureau approves in general the recommendations contained in the within report, and is of opinion that the next annual estimates to be submitted to Congress, of the bureaus concerned, should cover the most important items enumerated in the said report; these items being in the Bureau's opinion as follows :—Bureau of Yards and Docks : Building for power plant, $135,964; coal storage and handling plant for new power plant, $19,084: building for electric power plant extension, $97,983; machinery for electric power plant extension, $205,200; gun shop for medium and small calibre guns, $190,800; extension of east and west gun carriage and erecting shops, $334,448; new brass, iron and steel foundry and foundry yard, $300,170; new forge shop, $134,937; extension of gas plant, $9,961; locomotive house, $61,747; fire and telephone station, $14,752; fire-proof general storehouse, $289,152; steel timber shed, $40,320; sheet piled quay wall in front of old part of yard, $77,864; quay wall in front of extension of yard, $49,973; main sewer to extend to new

water front, $13,420; north and west walls to inclose extension of yard, $32,000; grading, $5,000; paving, $50,000; drainage, $5,000; fire protection, $20,000; railroad system, $25,000; underground conduit system, $20,000; dredging, $8,346; electric lighting, $5,000; telephone and time system, $2,000, making a total for yards and docks of $2,148,121. Bureau of Ordnance: Machinery for proposed gun shop for medium and small calibre guns, $368,930; machinery for proposed gun-carriage and erecting shop extensions, $666,232; machinery, cupolas, furnaces, etc., for proposed new brass, iron and steel foundry, $121,075; forges, hammers, furnaces and machinery for proposed new forge shop, $148,000, and machinery for locomotive house, $12,000, making a total for Bureau of Ordnance of $1,316,237."—*United States Army and Navy Journal.*

MILITARY NOTES.

PRINCIPAL APPOINTMENTS AND PROMOTIONS FOR OCTOBER, 1904.

Generals—General Sir A. G. M. Moore, K.C.B., from 18th Hussars, to be Colonel of the 4th (Queen's Own) Hussars.

Lieut.-Generals—Lieut.-General Sir E. Markham, K.C.B., to be Colonel Commandant of the Royal Artillery.

Major-Generals—Major-General H. S. Gough, C.B., C.M.G., to command the troops in Jersey while Lieut.-Governor of that island. Major-General B. A. Combe, C.B., to be Colonel of the 14th (King's) Hussars. Major-General T. Phillips, from the 14th Hussars, to be Colonel of the 18th (Princess of Wales's) Hussars. Major-General F. Ventris to be Colonel of the Essex Regiment.

Colonels—Colonel H. Barron to be a Major-General on the Staff to command the Royal Artillery, Malta, and is granted the rank of Major-General in the Army. Lieut.-Colonel C. E. Callwell, from D.A.Q.M.G., to be an Assistant Director of Military Operations at Head Quarters, and is granted the substantive rank of Colonel in the Army. Lieut.-Colonel and Brevet Colonel A. E. W. Colville, C.B., from h.p., to be Chief Staff Officer, Egypt, and is granted the substantive rank of Colonel in the Army. Lieut.-Colonel and Brevet Colonel T. Perrott, C.B., from h.p., to be Colonel on the Staff for Royal Artillery (temporarily).

AUSTRIA-HUNGARY.—*Partial Suppression of the Autumn Manœuvres.*—The Emperor decided that the Imperial Manœuvres, which should have taken place this year in Bohemia, should not be held, and that those of the Ist, IInd, IIIrd, VIIIth, IXth, Xth, XIth, and XIVth Army Corps should end on the 31st August. Commanders of army corps were invited to take the necessary measures to ensure the troops regaining their garrisons by the shortest way by road or rail, and that Reservists and the men of the class to be discharged should be sent back to their homes as early as possible. On the other hand, the original programme was maintained in its entirety for those units which are recruited in the Hungarian districts of the Monarchy. The XVth Army Corps and the troops of the Zara military district are not mentioned in the Imperial

order; these units should, as a matter of fact, terminate their manœuvres, according to the general programme, on the 27th and 31st August respectively.

According to the Austro-Hungarian press it was decided to do away with the autumn manœuvres in the public interest, the rural population having suffered greatly from the drought; the general measures taken with regard to them were merely an extension of those which were recently applied to the Xth Army Corps. The exception made with regard to the Hungarian troops is fully justified by the fact that the normal development of the training has this year been greatly retarded owing to the delay in the vote for the Hungarian portion of the contingent and consequent enrolment of the recruits, and also because grand manœuvres were not contemplated for the army corps recruited in the Hungarian districts of the Monarchy.—*Revue Militaire.*

Army Budget for 1905.—The Budget for 1905, which was announced as a second edition to that of 1904, has occasioned great surprise and some strong excitement in Austria-Hungary. Abruptly, and without previous warning, the Government, whilst submitting its draft of the financial law to the delegates, intimated the necessity for exceptional credits for the Army and Navy. Taken together, these credits, which are distributed over several years, entail a loan of 400 million kronen (a kronen equals about 9d. in English money). This sum is required for the following objects :—

Creation of a new field artillery *matériel*	222	millions
Completion and armament of ships being built ...	64	,,
Articles of equipment for the Army and Navy for which preceding budgets only gave small credits	110	,,
Total	396	,,

which the Government has further increased by 50 millions more as "approximate sum required for the introduction of the 2 years' period of service." The repair of artillery *matériel* was alone announced and agreed to. Public opinion has therefore been the more surprised to see other expenditure suddenly added to it, and especially the one under the vague heading of "Articles of Equipment." The first credits voted for artillery *matériel* amounted to the following :—

38 millions, voted in 1903, for field howitzers and new mountain artillery *matériel*;

15 millions, voted in 1904, first payment on account of Q.F. field artillery *matériel*.

These sums, already acquired, and the greater part of which have been placed in the hands of the War Minister, should, it is considered, permit of the incorporation in the projected loan of the 50 millions required for the 2 years' period of service. As regards the Army, the total expenditure for 1905 is distributed as follows :—

Budget.		
A. Ordinary Budget	289,355,923	kronen
B. Extraordinary Budget	19,640,252	,,
C. Supplementary Budget (Bosnia-Herzegovina)	7,663,000	,,
Total	316,659,175	,,

EXCEPTIONAL CREDITS.

Year 1904	10,000,000	kronen
,, 1905	78,000,000	,,
Total	88,000,000	,,

The Budgetary effectives for 1905 are as follows:—

—	Officers.	Officials.	Inferior Employés.	N.C.O.'s and Men. Re-engaged.	N.C.O.'s and Men. Not Re-engaged.	Horses. State.	Horses. Officers.
Ordinary Budget ...	16,559	4,435	875	15,427	269,238	39,171	10,349
Extraordinary Budget ...	6	28	—	—	4,467	1,632	—
Supplementary Budget ...	130	352	—	—	2,932	1,545	141
Totals	16,695	4,815	875	15,427	276,637	42,348	10,490

The Budgets, Ordinary and Extraordinary, of 1904 and 1905 have almost the same totals, but the distribution of the expenditure differs considerably, as will be seen from the following:—

—	Budget. Ordinary.	Budget. Extraordinary.
1904	285,846,529	22,210,350
1905	289,355,923	19,640,252
1905, greater or less credits	+3,509,394	-2,570,098

Exceptional Credits.—a. The creation and repair of field artillery *matériel*, estimated at a total of 222 millions, and for which there only remain 169 millions to be obtained, taking into account the amount already given (222-53) receives 50 millions in 1905. The amount of 15 millions voted in 1904 was, as a matter of fact, altogether insufficient for the object proposed, and the *matériel* ran great risk of being out-of-date at the time when the whole Army would be supplied with it.

b. The other 38 millions were distributed, 10 for the year 1904, and 28 for 1905, for the purchase and manufacture of "various articles of equipment necessary to render the Army fit to take the field, to which hitherto but insignificant credits have been devoted, and for which it is indispensable to ensure the prompt methodical settlement for several years." The details of these articles of equipment have not yet been published. If reference is made to previous Budgets, however, they will be found to probably consist of new field bakeries, field-railway, and ballooning *matériel*, field automobiles, etc., which do not, however, account for a credit of 38 millions.

Ordinary Budget.—The principal increases are due to the following:—1. The formation of a corps of officers for clothing. 2. Development of a second artillery cadet school at Traiskirchen. 3. Development of an Army School of Musketry and increase in the expenditure of ammunition. 4. Institution of professors of living languages in military schools. 5. Barrack improvement. 6. Development of the cadre of re-engaged men.

Extraordinary Budget.—2,000,000 kronen are devoted to the manufacture of small arms and of artillery ammunition consequent on the expenditure of previous years. The following fresh credits may be noted:—700,000 kronen, on account of a total of 2,100,000, to increase to 120 the number of cartridges of the infantry soldier, at present 100; 325,000 kronen, out of a total of 1,900,000, to organise the traction by locomotives of field railway *matériel*; 120,000 kronen for the installation of wireless telegraphy; 1,000,000 kronen for the development of and for the mounting of guns at the Hajmaker range, belonging to the present Artillery School of Gunnery, which is altogether insufficient. A sum of 4 millions should be devoted to this object.—*Précis* from *Revue Militaire.*

GERMANY.—*The Imperial Manœuvres, 1904.*—The *Strassburger Post* gives the following account of this year's Imperial Manœuvres:—

The General Idea was as follows:—

"A Blue Army is concentrated on the eastern frontier of the Empire, whilst a Red Army Corps has disembarked on the Schleswig coast, and on the 6th September has arrived at Hamburg: the Red Fleet is mistress of the Baltic."

The Guards Corps (Blue) representing the advance guard of the Blue Army, at first faced west on the Warmitz, Gross-Trepow, Klein-Trepow line, where it had the lake of Schwerin in its rear. In order to extricate itself from this embarrassing situation, it had to first of all make a change of front and endeavour to drive back the enemy towards the Baltic by taking a vigorous offensive. With this object it swung round to the right during the night of the 13th September, and the Red force was compelled, by this manœuvre, which threatened its flank, to also change its direction. The latter thus found itself on the Dragun, Cramon, Muhlen, Eichsen, Diedrichshagen line, a position in which the Guards Corps attacked it by turning its right flank, the 2nd Guards Division pushing up to Vietlubbe, the 1st towards Gottmansforde, and the 3rd by Cramonshagen.

The IXth Corps (Red) thus found itself, having on its right the "A" Cavalry Division, on the Rehna-Hindenberg-Steinfort-Klein-Kraakow line, and consequently facing south. The Guards' Cavalry Division (Blue), which was on the left flank of its force, advanced on Gadebusch, and remained there, whilst the two army corps prepared for the attack. The Guards Corps (Blue) took the offensive, its 3rd and 1st Divisions engaged in a frontal action, endeavouring by their fire to keep the enemy fixed in its place, whilst the 2nd Division advanced to the attack towards Grambow and there outflanked the 17th Division (Red), which was on the road from Hindenberg to Weelboken, and was itself just about to take the offensive. The latter attempt, however, was not successful, for at the same time the 1st Guards Division advanced in the direction of Goddin, thus preventing assistance being brought to the 17th Division.

The IXth Corps (Red) were thus forced to fall back towards the north-east, and drew near to the Gulf of Wismar, where a mixed brigade of its forces was in process of disembarkation, covered by the fleet. These reinforcements, which marched to the sound of the guns, arrived, nevertheless, too late to take part in the action, owing to the distance, but were the cause of eventually permitting the IXth Corps to resume the offensive. During the attack of the 1st Guards Division, the 1st Guards Regiment was seen marching to the attack with drums beating and colours flying. The *Strassburger Post* looks on this as theatrical, and as recalling to recollection the glacis at Saint-Privat.

The IXth Corps (Red), which was repulsed on the 13th September, occupied a totally different front on the following day. On the 14th, at 8 a.m., its 17th Division was posted on the Noschendorf-Quaal line, with the 18th near Bobitz. The 18th Division, with the "A" Cavalry Division, attacked the left flank of the Blue force, which was thus distributed:—The 3rd Guards Division on the Gross Eichsen, Moltenau front; the 1st Guards Division, in the centre, near Muhlen-Eichsen; the 2nd Guards Division on the road towards Testorfer-Steinfort; whilst the Guards Cavalry at the same time threatened the right flank of the Red force.

Both forces selected for the preparatory artillery duel well sheltered positions, and had strengthened them by field works which the nature of the undulating and broken ground rendered easy. The centre of the two positions was marked by the Grevesmuhlen main road—to Bobitz for the Red and to Dallendorf-Schönhof for the Blue force. The main action took place near Bobitz, and was preceded by a terrific artillery duel for two hours, during which the infantry of both forces took hardly any part in the action, and remained almost invisible. When the 17th Division (Red) advanced to the attack against the 2nd Guards Division (Blue) towards 9.15 a.m., it was stopped by an attack of the Guards Cavalry Division. The 1st and 2nd Guards Divisions maintained their positions at Testorf, Harenshagen, Schönhof, and Dallendorf, and thus permitted the 3rd Guards Division to carry out an enveloping movement against the right flank of the Red force. After this movement had succeeded, the 1st and 2nd Guards Divisions advanced with drums beating and colours flying in great columns on both sides of the main road from Gadebusch to Wismar against the enemy's centre near Bobitz; at the same time the Guards cavalry threatened its left. During the action the cavalry intervened on several occasions. The Emperor on that day commanded the Guards Corps in person. The troops suffered considerable hardships, owing to a wet night passed in bivouac and soft ground. The 37th Infantry Brigade disembarked on the 13th September, and, belonging to the Red force, was not available before 9 a.m. near Gross-Walmstorf. It took no part in the battle. The commander of the IXth Army Corps (Red), General von Bock und Polak, had to fall back on Gressow.

On the 15th September, the last day of the manœuvres, the Emperor assumed command of the Red forces (the IXth Army Corps and the landing troops), and victory changed sides with him. The IXth Army Corps had been reinforced by the 37th Brigade, disembarked by the fleet, and by a landing force of 2,500 bluejackets, landed early in the morning near Wohlenberg; it had, in addition, the support of the guns of the fleet, which was cruising in sight of the coast. At 7 a.m. the IXth Army Corps was posted in a very strong position on the heights of Hockendorf-Manderow, in the centre of which its artillery took up a position protected by field works. At 500 yards from the coast, the coast-defence vessels and the small cruisers of the fleet were anchored ready to intervene. At a distance of 17 kilometres at sea, 10 large cruisers and armoured cruisers were within sight, and communicated by means of optical signals and wireless telegraphy with the Emperor and the landing force. The 17th Division was posted at Hundersdorf; the 18th at Hockendorf; the 41st at Eggersdorf; the cavalry was kept on the left flank. The landing force received instructions to await orders before engaging in action. In the Blue force, the 1st Guards Division was posted at Weitendorf; the 2nd at Gressow; the 3rd formed the left wing, extending from Meiersdorf to Barendorf; whilst the Guards cavalry marched north from Diedrichshagen. The evident object of these opera-

tions was to cut the line of retreat of the Red force towards the sea. The action commenced with a furious attack by the Guards against the positions mentioned above. The 1st and 2nd Guards Divisions first came into action, and fell under the concentrated and terrific fire of the Red artillery, which compelled them to halt on the Barendorf-Jamel-Jassewitz line, the 41st Division at the same time outflanking the Blue lines. At 10.30 a.m. the IXth Army Corps, in its turn, assumed the offensive, and at about 11 a.m. the commander of the squadron received orders to intervene in the action with his coast-defence vessels and small cruisers. A tremendous cannonade ensued, directed against the Blue force, and at the same time the 1st Guards Division was charged by the "A" Cavalry Division. The naval landing force, with 28 Q.F. guns and 40 machine guns, was first directed against the Guards' right flank and afterwards called to the assistance of the 41st Division (Red). The Guards' attack was declared repulsed by the umpires, and at the end of the manœuvres, at 11.20 a.m., the IXth Army Corps had advanced as far as Jemel-Wolde.

The *Strassburger Post* points out that the present is not the first occasion on which it has urged the necessity for reforming military methods with regard to reviews, viz.: the abolition of the parade step, which is most fatiguing to the soldier to learn, which causes a regrettable loss of time—time which would be far better employed in drill and manœuvre. By now extending to the Navy customs that should be abolished in the Army, an act of unquestionable clumsiness is perpetrated. It is not by the training of bluejackets to the parade step that harmony will be created between the Navy and Army, a harmony so necessary to their mutual and intelligent co-operation in war.

The same journal proceeds to give an account of the tactics employed during the recent German manœuvres:—

The Infantry was employed conformably to regulation and with the tradition of preceding years, viz.: Contact established along the entire front and a strong and enveloping pressure on the flank most dangerous to the enemy's retreat. The so-called "Boer tactics" were altogether discarded. The greater or less density of the skirmishing lines essentially depends on the accidents of action and of ground. The latter, broken and intersected, lent itself favourably to the employment of infantry and of artillery, but less so to that of cavalry. Pre-eminence was always given to the battle preparation and to fire action. Great use was made of machine guns at medium ranges, where the accuracy was greater than that of the rifle. The rifle is regarded as the main weapon at short ranges of from 600 to 800 metres, which the infantry should endeavour to take up before opening fire, so as to avoid excessive expenditure of ammunition. As soon as the envelopment on the flank makes itself felt, the attack on the whole front is proceeded with, supported by the artillery, which should not hesitate to approach closely to the objective to be destroyed.

Artillery is always employed in masses. Batteries come into position with as small a front as possible without allowing the guns to be seen above the crest line. Shrapnel is regarded as the chief projectile for artillery. It was not observed that the light field howitzer batteries played any special *rôle*. In all cases the artillery was prepared to intervene in full strength to assist and support the infantry.

The Cavalry found fewer occasions this year than in preceding ones of intervening in battle in masses. A judicious use was, however, made of reconnoitring and of security service. The ground, as has been already mentioned, lent itself but little to the concentration of large

masses of cavalry, and corps of that branch of the service were not formed as usual by the junction of two divisions. Several regimental and brigade charges were delivered in order to draw off a harassing attack or to relieve troops who were being badly pressed. Cavalry telegraphists were greatly employed with scouting parties. Cavalry bridges were not used at all, in consequence of the nature of the ground.

Pioneers assisted the infantry in organising defensive positions. Line of communication troops were represented by telegraphists and balloonists. The former linked together the various headquarters, whilst the latter rendered excellent service on captive balloons. According to the *Strassburger Post*, one balloon was burnt and another burst.

JAPAN.—*Armed Strength.*—So many discussions have taken place as to the number of men which Japan can actually put in the field that it may be of interest to give a *précis* from a well-written article on the subject that has recently appeared in the *Novoye Vremya* :—

The population of Japan (45,000,000) furnishes every year a contingent of young men 20 years of age, amounting to 450,000. After the elimination of the physically unfit and cases of complete dispensation, there only remain 175,000 men, of whom, during recent years, 45,000 enter the permanent Army; of the remaining 130,000 men, 80,000 are posted to the 1st Category of the Recruiting Reserve, and the remainder, about 50,000, who are not so fit for service, into the 2nd Category of this Reserve. The 45,000 young men drafted into the Regular Army serve in it for 3 years, then for 4 years and 4 months in the Reserve, 5 years in the Territorial Army, and 8 years in the Reserve of that Army, which brings them up to the age of 40. At the same time the law does not permit of men, belonging to the Reserve of the Territorial Army, being employed outside the limits of the country. The military authorities, therefore, only have entirely at their disposal for war those classes who are less than 32 years of age. The recent change in the law of recruiting in Japan has had the effect of prolonging by 5 years the service in the Territorial Army, and to consequently render available for service outside the kingdom all the classes up to the age of 37 years.

The 1st Category of the Recruiting Reserve, 80,000 young men a year, has been receiving for some years, during 6 months, an abbreviated military training. As regards the 50,000 young men of the 2nd Category, they receive no military training whatever. If the different classes were complete, the recruiting law existing before the war should have given Japan in thoroughly drilled troops :—

		Men.
a.	Classes from 20 to 22 years of age	135,000
b.	,, ,, 23 ,, 26 ,, ,, ...	180,000
c.	,, ,, 27 ,, 31 ,, ,, ...	225,000
d.	,, ,, 32 ,, 39 ,, ,, ...	360,000
	Total	900,000

Men Having an Abbreviated Military Training.

a.	Classes from 20 to 22 years of age	240,000
b.	,, ,, 23 ,, 26 ,, ,, ...	320,000
c.	,, ,, 27 ,, 31 ,, ,, ...	400,000
d.	,, ,, 32 ,, 39 ,, ,, ...	640,000
	Total	1,600,000

Men with no Training Whatever.

a.	Classes from 20 to 22 years of age	150,000
b.	,, ,, 23 ,, 26 ,, ,, ...	200,000
c.	,, ,, 27 ,, 31 ,, ,, ...	250,000
d.	,, ,, 32 ,, 39 ,, ,, ...	400,000
	Total	1,000,000

This would give as a grand total 3,500,000 men really available, of whom 1,500,000 are less than 32 years of age, and theoretically thoroughly or partially trained; but a certain natural annual wastage of the recruiting classes must be taken into account, which would reduce the number of trained and partially trained men of less than 32 years of age to the following figures :—

Trained Men.

a.	Classes from 20 to 22 years of age	122,000
b.	,, ,, 23 ,, 26 ,, ,, ...	163,000
c.	,, ,, 27 ,, 31 ,, ,, ...	180,000
	Total	465,000

Partially Trained Men.

a.	Classes from 20 to 22 years of age	216,000
b.	,, ,, 23 ,, 26 ,, ,, ...	272,000
c.	,, ,, 27 ,, 31 ,, ,, ...	320,000
	Total	808,000

This brings the number of wholly and partially trained to 1,273,000, instead of 2,500,000, or even to 1,200,000 in round numbers.

The author of the article in the *Novoye Vremya* does not think that the Japanese had their cadres necessarily limited, or in view of the losses naturally caused by the war that they have increased the number of their units by fresh levies, so as to be able at the commencement of the war to place their 465,000 completely trained men, between the ages of 20 and 31 years inclusive, in the field. He is of opinion that they contented themselves with calling to the colours the 350,000 men necessary to fill their normal effectives, leaving the 115,000 available to make good inevitable losses. He even considers it probable that amongst the 350,000 men called out on or since the commencement of the war, there was a certain proportion of partially trained men of the junior classes which would permit of the retention of a larger number of thoroughly trained men available for the purpose of either filling the vacancies with a superior *personnel*, or to eventually serve as a nucleus for fresh formations. The author estimates, in a somewhat sanguine fashion, that the Japanese losses since the beginning of the war, amount to 150,000 men killed and wounded, and by adding as many more for sick, he obtains a total of 300,000 casualties altogether!

According to him it has, therefore, been necessary for the Japanese to transport 300,000 to the continent to replace these losses, that is to say, to use up, in addition to the 115,000 thoroughly trained men referred to above, 185,000 partially trained men, of which there consequently only remain 623,000 of a less age than 32 years. The effective of the Army of Operations being maintained at 350,000 men, and 623,000 still remaining in Japan, the total number of men of less than 32 years of age and more or less trained would still be 973,000.

The recent change in recruiting law, which brings the period of service in the Territorial Army and of the category of men who may be employed outside the kingdom up to the age of 37 years, places 5 more classes at the disposal of the military authorities, or, taking into account natural wastage, 1,080,000 men more. The grand total of men theoretically more or less trained, and aged less than 37 years, and consequently available for war, amounts therefore to 2,050,000 men. Finally the grand total of men of the same category aged less than 40 years should amount, in round numbers, to 2,570,000.

It only remains to examine, says the journal, how the 350,000 men would be distributed who are permanently maintained at the theatre of war. The author of the article admits that each of the Japanese divisions on a peace footing has been enlarged by two reserve brigades, and has become in consequence a regular army corps, consisting of 20 regular or reserve battalions, 6 squadrons, 1¼ battalions of engineers, 1¼ transport battalions, and 10 batteries, or, in round numbers, 20,000 men and 60 guns. The Japanese should have 14 of these divisions in Manchuria (in consequence of the relief of the Formosa Division by territorial troops), that is to say, 280,000 men, and, with supplementary artillery and cavalry brigades, 300,000 men. The 50,000 surplus men would be grouped in reserve brigades occupying Korea or on the lines of communications, furnishing men to replace those of the first line, and being themselves reinforced by means of reservists sent from Japan as they are required. But in addition to this fighting effective there must be included the numerous coolies who accompany the Japanese troops, and who during the operations in China in 1900 amounted to 8,000 for a Japanese division of 12,000 men. In that case the effective of a Japanese division in the present war, including coolies, would amount to about 30,000 men. What is to prevent, says the author, these coolies from laying down their loads, and of being employed in the fighting line to fill vacancies? Here probably, he observes, is the explanation of the absolute impossibility the Japanese have experienced of pushing on after each of the battles fought since the commencement of the war. In this case it becomes necessary to appreciably increase one's estimate of the Japanese effectives. The 11 divisions or army corps which face General Kuropatkin, instead of 220,000, amount in reality to 330,000 provided with 660 field and mountain guns, and, taking into account the cavalry and artillery brigades and the heavy artillery *matériel*, the Japanese forces in Manchuria would reach a total of 350,000 men, instead of 240,000, with 900 guns. The 3 divisions operating before Port Arthur should be estimated, not at 60,000, but at 100,000 men with 200 field and as many siege guns, not taking the Japanese fleet into account. In addition, the Japanese have on their lines of communication, 50,000 reserve troops with 200 guns. There would, therefore, be a total at the theatre of war of 500,000 Japanese with 1,500 guns, including troops and coolies of all sorts.

Regulations for the Sanitation of the Battle-field and for the Burial of the Dead.—On the 30th May last the Minister of War issued a regulation on this subject, which it may be of interest to give the translation in full :—

1. Immediately after an engagement each unit will organise a detachment to purify the battle-field, to search for the sick, wounded and dead, as well as for the equipment left by them on the battle-field. The senior

officer will command a special detachment to ensure the carrying out of this service.

2. The sick and wounded will be treated conformably with the regulations laid down for the medical service of the Army in the field. The dead will receive such honours and marks of respect as their rank entitles them to, whether they belong to the Imperial Army or to that of the enemy.

3. The most minute examination possible will be made of the small book, badges, uniform, identity plates, etc., in order to ascertain the complete name, rank, position, relations, and regiment of every man found dead.

4. The bodies of men belonging to the Imperial Army will be cremated; those of the enemy buried, except in the event of contagious or infectious diseases, when all the bodies will be cremated.

5. No burial will be made without a definite assurance of death.

6. The sanitary detachment will assemble separately the corpses of the two Armies in one or more places, and will cover them with matting. Even when it is impossible to gather the corpses together, steps should be taken to cover them.

7. When the measures mentioned in Paragraph 6 have been taken the corpses should be separated, those of the Imperial Army on one side, and those of the enemy on another. They will then be cremated or buried as soon as possible.

8. As regards places of burial, the following arrangements, especially the two first, will be noted :—

a. The ground should be at some distance from all roads, towns, villages, or garrisons;

b. The ground should be far from springs, streams, wells, or other sources of drinking water;

c. The ground should be on a plateau or on a gentle slope; the soil should be cleared and be more or less dry.

9. The corpses of men belonging to the Imperial Army should be cremated separately, and one of the bones (the larynx) should be sent to Japan. Should circumstances prevent the carrying out of this latter order, only the hair and the bones will be buried temporarily on the battle-field. Should circumstances prevent separate cremation non-commissioned officers and men will be cremated together, and the hair alone will be sent to Japan.

10. The bones and the hair will be sent to Japan and buried in the cemetery in conformity with Para. 6 on the burial of soldiers. If required the bones and hair may be sent to the relatives of the deceased for burial. The remains, temporarily buried on the battle-field, should be sent to Japan, where they will be interred in a cemetery.

11. In the event of corpses having been interred under the conditions of Para. 9, the following should be noted :—

a. The bones of officers, warrant officers, and of senior non-commissioned officers will be buried separately;

b. The bones of soldiers of other ranks should also be buried separately; when, however, circumstances do not permit of this, they may be buried together;

c. In all cases the bones of the senior non-commissioned and warrant officers should be buried separately.

12. In the burial of an enemy's corpse, the following should be noted :—

a. Corpses of officers, warrant officers, and senior non-commissioned officers should be buried separately;

b. Corpses of men of other ranks should also be buried separately or in numbers less than 50.

c. Graves should be a metre in depth.

d. The bottoms of the graves should be covered with branches of trees or straw, on which the corpse will be placed; a covering of lime, coal, cinders or ashes will be laid on the body, and all sanitary precautions will be taken;

e. The earth taken from the excavation will be replaced on the grave so as to form a small hillock.

13. Corpses belonging to the Imperial Army which are buried will be s· according to the regulations laid down in the above Para. Some hair from each corpse will be kept.

14. When enemy's corpses are cremated, the bones will be buried in accordance with Para. 11.

15. The graves of the dead of the Imperial Army will be separated from those of the enemy, each receiving a special mark of identification.

16. In the case of every burial, Shinto, Buddhist rites and those of other religions will be observed.

17. Should the corpses of natives of the country be found on the battle-field, they will be buried similarly to those of the enemy. If they are claimed by their relatives, they will be given up to them when possible.

18. The personal effects of the dead of the Imperial Army will be made up into packets, with the bones and the hair, and addressed, with the complete name, rank, and regiment of the deceased. The packet will be sent to the Staff of the division where the deceased was mobilised or to the office where the organisation of his corps was made.

19. The name, age, nationality, position, rank, and regiment of the dead belonging to the hostile Army, if known, will be placed on a list, which will be forwarded by the divisional staff or by the officer in charge of the Office of Information for Prisoners at Tokio. The personal effects, excepting the arms, horses, etc., will be packed, and the parcel, addressed with the complete name and rank of the deceased, will be forwarded to the above-named office.

20. Effects of deceased inhabitants of localities will be forwarded to the local authorities by the divisional staff or by the troops, to be sent t the relations of the deceased.

21. Arms, horses, provisions, and other objects left on the battle-field without owners will be taken charge of by the divisional staff or by the district troops. All other articles, except those belonging to the Imperial Army, will be regarded as trophies.

22. The manner in which the funeral rites will be carried out, the disposal of effects belonging to the dead, and the description and number of the effects will be reported by the district staff to the General-in-Chief.

23. Dead horses will be buried or cremated, and in burying them the orders *a* and *b* of Para. 12 will be observed. Special sanitary measures will be taken.

24. These regulations will apply to the treatment of the dead and their effects throughout the entire theatre of operations, even outside the immediate vicinity of the battle-field.

Horse Breeding in Japan.—A recent number of the *Neue Militärische Blätter* publishes a long article on the above subject, from information furnished by the head of the Japanese Veterinary Department. The following are some of the essential points :—

The organisation of horse breeding is by no means a novelty in Japan. As early as 1532 Arab sires were introduced into the country, and at that period there were already public stud farms and remount depôts. In 1778 there were 20 of these stud farms, and Dutch and Persian sires were introduced. In 1861 the French Government made a present to Japan of 15 Arab stallions and 11 mares. In 1870 Japan began to take American breeding as her model, and gradually developed studies with a view to showing the type of horse most suitable to Japan.

The best breeding districts are the provinces of Aomori, Ioate, Akita, Kagoshima, Mijagi, and Fukushima. Each of them possesses special types, differing from one another in form, height, etc. From 1861 to 1868, 265 foreign stallions were introduced, 96 of which were Algerian and 65 American, at Government expense, not including those imported by private individuals, but the results obtained vary greatly in different provinces. The produce of Aomori, from English, American, and Hungarian sires are satisfactory. At Mijagi, American, Hungarian, Arab, and English stallions were introduced. At first the foals of Hungarian sires were weak, but the results have improved. The colts of American sires are bad; those of Algerian too weak; the best sire has been the Arab horse. At Akita, American sires produce good saddle and draft horses; Algerians, too, have, as a rule, given good results. The results are, however, very dissimilar. The American saddle and draft horses, which are so good in Akita, are but weak and delicate in Mijagi. The Algerian stallion, a moderate sire in Aomori, gives good results at Kagoshima and Akita.

The following are the causes of the moderate results of horse breeding in Japan :—

1. Defective selection of sires.
2. Insufficiency of feeding and work for foreign horses, many of whom died in consequence.
3. Moderate value of native mares.
4. Ignorance of the basis of breeding.
5. Increase of the population and decrease of pasturage.
6. Want of perseverance on the part of the Government, and the abandonment of breeding to private individuals.
7. Want of unity of system.
8. Absence of stud book.
9. Moderate choice of stallions in private stud farms.

In 1895 a Commission was formed, but it was only given a provisional credit of 12,600 yen. On the outbreak of the Chino-Japanese War 40,000 horses were required. This gave an impetus to the breeding question, and it was decided to form new State depôts, to give greater care to the selection of stallions, to supervise private stud farms, give prizes, etc. Unfortunately all these efforts were crowned with but small success on account of the lack of taste on the part of the population for horse breeding. The Chino-Japanese War brought the insufficiency of Japanese horse breeding prominently to the front. Of the 11,000 horses raised on a divisional district 2,700 were rejected as too small, 3,000 as being less than 5 years, and 300 as being more than 15 years, or altogether 6,000—more than half as unfit for service. All had, however, to be taken in the end for want of better. At the present time, energetic endeavours are being made to form new stud farms and remount stations, but for the present war Japan has had to purchase largely in America and Australia.—*Novoye Vremya, La France Militaire, Revue Militaire des Armées Etrangères,* and *Neue Militärische Blätter.*

WAR NOTES.

The Baltic Fleet.—The Baltic Fleet, under the command of Rear-Admiral Rodjestvensky, or, as presumably it should now be called, the Second Division of the Pacific Fleet, seems to have at last fairly started for the Far East. The constitution of the fleet is as follows :—

First Division.

First-class battle-ships.—"Kniaz Suvaroff" (flag-ship of Commander-in-Chief), "Borodino," "Imperator Alexander III.," "Orel."

Second Division.

First-class battle-ship.—"Osliabya."

Second-class battle-ships.—"Sissoï-Velikie" (flag-ship of Rear-Admiral Folkersam), "Navarino."

Cruiser Division.

Belted cruisers.—"Admiral Nakhimoff," "Dmitri Donskoi."

Second-class cruisers.—"Oleg," "Aurora."

Third-class cruisers.—"Almaz" (flag-ship of Rear-Admiral Enquist), "Svietlana," "Jemtchug," "Izumrud."

Destroyers.—"Bravy," "Bystry," "Boïny," "Bodry," "Bedovy," "Bezoupretchny."

With the auxiliary cruisers "Ural," "Don," and "Volga," the hospital-ship "Orel," the factory-ship "Kamtchatka," and some colliers. According to latest reports, neither the "Oleg" nor "Jemtchug" has yet left Libau, but both vessels, convoying some torpedo-boats, are to leave to join the fleet as soon as possible.

The first battle-ship division is composed of the four latest completed ships, and are practically sister-ships to the "Tsarevitch," now lying dismantled at Kiauchau; the "Osliabya" is a sister-ship to the "Peresviet" and "Pobieda," both of which form part of the Port Arthur fleet; while the "Sissoï-Velikie" and "Navarino" are both small and comparatively-speaking old ships, the first-named also, during her last commission in China, developed some serious structural weaknesses. Both the belted cruisers are obsolete vessels, while the "Oleg" and "Aurora" are new ships, as are also the "Almaz," "Jemtchug," and "Izumrud," the two last being improved "Noviks."

The fleet left Libau on the morning of the 15th ult., the destroyers called at Cherbourg on Monday, 24th, and after coaling, left again for Tangier, coaling again en route at Arosa Bay; they arrived at Algiers on the 31st ult., and having coaled, have since proceeded to Suda Bay. The First Division of the fleet arrived at Vigo on the 26th ult., and left again for Tangier on the morning of the 1st inst., where they arrived on the evening of the 3rd inst., the Second Division and cruisers apparently coaled at or off Arosa Bay; the whole fleet, with the exception of the destroyers being assembled at Tangier on the 3rd inst.

The First Division with the "Osliabya" and the larger cruisers are reported to have left Tangier on the 6th inst., steaming in a south-westerly direction into the Atlantic, and it is believed that they are to go round the Cape, coaling at the French African ports, and rejoining the rest of the fleet at some rendezvous in Eastern waters. The "Sissoï-Velikie" and "Navarino," with the smaller

cruisers, have left Tangier for the East, and are to proceed through the Suez Canal with the destroyers, as it would be impossible for either the "Sissoï-Velikie" or the "Navarino" to attempt the Cape route.

The last great battle in Manchuria, that of Sha-Ho, ended on the 18th October, after raging for ten days, and left the situation practically unchanged. The Russians, as stated in last month's JOURNAL, were driven back at all points, but did not meet with an overwhelming defeat. The troops engaged are roughly estimated at 250,000 on each side. According to the Russian official account their losses amounted to 45,000, whilst the Japanese state their losses to have been 15,879 men. The Japanese state that they buried 13,333 dead Russians, and that they captured 35 guns, 6,920 shells, 5,574 rifles, and 78,000 rounds of ammunition.

Nothing of importance has taken place since the battle on the Sha-Ho, the two contending armies are still observing one another closely. There are affairs of outposts and of detachments daily, and some artillery firing. Both sides are heavily entrenched, and the general situation is one of great tension.

The Japanese have been steadily progressing in their attack on Port Arthur since last month, desperate fighting has been going on round that fortress, and according to official Japanese accounts many important surrounding forts have been captured. It is, however, impossible to form a definite opinion of the actual advance made owing to the lack of reliable maps. The Japanese have undoubtedly brought heavy guns to bear on the harbour and shipping, and are reported to have sunk several steamers, and to have caused conflagrations in the neighbourhood of the docks.

NAVAL AND MILITARY CALENDAR.

OCTOBER, 1904.

1st	(Sat.)	H.M.S. "Formidable" commissioned at Portsmouth for Mediterranean.
,,	,,	13th Hussars arrived in India from England in the "Assaye."
3rd	(M.)	Announced that the Mullah had raided the Ogadens in Somaliland and killed 600.
5th	(W.)	H.M.S. "Formidable" left Portsmouth for Mediterranean.
,,	,,	Some Portuguese troops were ambushed by the Cuanhamas in Africa and lost 300 killed and wounded.
7th	(F.)	H.M.S. "Eclipse" arrived at Spithead from China.
,,	,,	A fourth Japanese Army was formed and sent to the front.
8th	(Sat.)	Launch of new scout "Foresight" from the Fairfield Shipbuilding Yard, Govan.
,,	,,	General Kuropatkin published a message to the Russian troops and ordered a general advance south.
10th	(M.)	The Mikado delivered a message to the Japanese people.
11th	(T.)	H.M.S. "Hermione" commissioned at Devonport for relief service to East Indies.
,,	,,	Launch of first-class battle-ships "Georgia" and "Nebraska" from the Bath Ironworks and the Yard of Moran Brothers, Seattle, respectively, for U.S. Navy.
12th	(W.)	Launch of the new scout "Patrol" from Messrs. Cammell, Laird & Co., at Birkenhead.
,,	,,	Launch of first-class battle-ship "Vittorio Emanuele" from Royal Dockyard, Castellamare, for Italian Navy.

13th (Th.) H.M.S. "Diana" left Plymouth for Mediterranean.
" " The Russian southward movement was arrested at Yentai by the Japanese, who repulsed and defeated the Russians all along the line and captured many guns. The Japanese official report states that their total casualties during the 5 days' fighting amounted to 15,879, and that they buried 13,333 Russian dead. The Russian official report gives their total casualties at 45,000 men.
14th (F.) 2nd Bn. Cheshire Regiment arrived in India from England in the "Soudan."
" " 4th Dragoon Guards arrived in South Africa from India in the "Avoca."
15th (Sat.) King George of Saxony died.
18th (T.) The Russians captured 14 guns from Brigadier-General Yamada's column, which was surrounded at the battle of Sha-Ho, but cut its way out.
19th (W.) H.M.S. "Terrible" arrived at Plymouth with relieved crew of H.M.S. "Albion" from China.
" " H.M. the King visited Woolwich and inspected the Royal Artillery.
20th (Th.) Head Quarters and rear column of the British Expeditionary force reached Chumbi from Lhassa.
" " 16th Lancers left South Africa for England in the "Dunera."
21st (F.) H.M.S. "Hermione" left Plymouth for East Indies.
" " H.M. the King visited Chatham and inspected the Royal Engineers.
" " 1st Bn. Cheshire Regiment left India for England in the "Soudan."
22nd (Sat.) The Russian Baltic Fleet, on its way to the Far East, shelled a British fishing fleet off the Dogger Bank, in the North Sea, sinking 1 vessel, killing 2 fishermen and wounding 6.
24th (M.) The British Government demanded from the Russian on account of the North Sea outrage:—1. A full apology; 2. Adequate compensation; 3. Punishment of the guilty officers; 4. Security against similar occurrences.
25th (T.) General Kuropatkin was appointed Commander-in-Chief of the Russian forces in the Far East.
27th (Th.) H.M.S. "Hogue" commissioned at Devonport for China.
28th (F.) The Prime Minister announced at Southampton that the Russian Government had practically acceded to the British demands, and that an International Court of Inquiry would be held on the circumstances of the North Sea outrage.
" " Lord Kitchener's scheme for the redistribution of the Indian Army was approved and was estimated to cost £10,000,000.
" " The Japanese recommenced a fierce attack on Port Arthur and captured some forts.
29th (Sat.) H.M.S. "Sutlej" commissioned at Chatham.

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The United Service. New York: October, 1904.—"West Point—Her Sons." "A Tour in Southern Manchuria in September, 1901." "The Campaign and Battle of Shiloh." "The Strategy and Tactics of the Russo-Japanese War" (*continued*). "How Russia Brought on War." "Our Contemporaries." "Editorial Notes." "Service Salad." "Colonel John Jacob Astor."

NOTICES OF BOOKS.

Guerilla or Partizan Warfare. By T. Miller Maguire, M.A., LL.D. 8vo. Hugh Rees. London, 1904.

There is little in the history of wars great or small that Dr. Maguire could not describe from memory, and if there is any campaign with which he is unfamiliar, he could, at all events, name at a moment's notice the works that should be consulted in reference to it. Needless, therefore, is it to say that these chapters on "Guerilla and Partizan Warfare," which every officer should make a point of reading, cover a very wide field of historical research, are full of valuable information, and contain many useful lessons. An object which Dr. Maguire had in view when he wrote, at a time when the guerilla warfare in South Africa was not yet over, seems to have been to contrast the mistaken leniency displayed by the British towards the Boers, with the more stringent and consequently more effectual measures that have always been employed in similar circumstances, and will be again by any other nation than our own.

With the exception of the establishment of "concentration camps," for which the American Civil War and other campaigns afford precedents, nothing was done by the British to coerce the hostile Boer population, in addition to the ill-advised burning of farms, which hindered rather than assisted the object in view, and merely resulted in impoverishing the country. A judicious use of the gallows, early in the proceedings, applied at once to rebels taken in arms, and after fair warning to Transvaal or Free State Boers who had broken the oath of allegiance, would probably have resulted in a speedy collapse of the resistance and a great saving of human life. There are times when apparent cruelty is the truest kindness.

From the exploits of De Wet and others there is not much to be gathered that will bear comparison for one moment with the far more skilful enterprises of Mosby, Stuart, Ashby, and others, on the side of the Confederates, or of Grierson, on the side of the Federals, who must always hold places in the very highest rank as partizan leaders. Neither Boers in South Africa nor Spaniards in the Peninsula ever displayed the perfect combination of daring, resourcefulness, and genuine military

skill that marked the raid accomplished by Stuart right round McClellan's army, when this brilliant leader wrought such immense destruction upon the transport and supplies of the enemy, and returned, almost without loss, having discovered everything that Lee could desire to know. Ashby and Mosby both did splendid service, but the only man who performed a feat of arms worthy to be compared with that of Stuart, was Grierson, whose wonderful ride into the Mississippi country had results for Grant even greater than those which Stuart won for Lee.

The examples of all kinds quoted by Dr. Maguire, and taken from almost all countries, are legion; guerillas in South Africa, partizans in the United States, the brave peasantry of La Vendée, the blood-thirsty and crafty Spaniards, who, under "the Empecinado" and many others, proved so sharp a thorn in the side of the French in the Peninsula; Montenegrins, Circassians, Albanians, Afghans, and many more. Due notice is taken of Schamyl and Scanderberg: and Bou Maza, the trusty lieutenant of Abd-el-Kadir, is rescued from oblivion.

The "small wars" in which the British Army is so constantly engaged are usually guerilla wars pure and simple, or nearly akin thereto; thus the importance of such a book as Dr. Maguire's is very great. Every chapter contains a very great deal from which officers and others who may read it can scarcely fail to gather a large number of useful lessons, in view of future wars in which colonial corps may be fighting for the Empire.

Notes for Officers proceeding to India. Compiled by Major A. T. Moore, R.E., Secretary R.E. Institute, Chatham. 8vo. 3s. 6d.

This is a very useful little publication, and contains valuable hints for officers and others proceeding to India for the first time. Originally the Notes were compiled to form part of one of the "Descriptive Accounts of Foreign Stations," issued to members of the R.E. Institute when proceeding abroad. It having been suggested that the information contained in the pamphlet might be useful to officers of other branches of the Army and also to Indian civil officials, the sections dealing solely with matters concerning Royal Engineer Officers were published in a separate form; and the remainder, after some amplification, is now offered for general use.

Part I. deals with outfit, passages, procedure on arrival, hotels, quarters, cost of living, servants, horses and dogs, amusement and sports, health, and concludes with some valuable hints for ladies and about the clothing and care of children. Altogether into the thirty-five pages of the first part an astonishing amount of useful information has been compressed.

Part II. is also full of interesting information put into a readable and concise form, giving the physical features of the country, details about the rainfall and temperature; railways, roads, and canals; the population and Administration; the Military Organisation and Native Army, and the three principal historical epochs of India. Then follow some excellent sketches of the languages, races, castes, and characteristics, and the various religions of the inhabitants of our vast Indian Empire, with all of which subjects the author has evidently more than a passing acquaintance. The Notes conclude with three appendices, the first of which gives the coinage, weights and measures in vogue in the country; the second, which is more a chapter than an appendix, is devoted to shooting hints; while the third is a

vocabulary of useful words. The author has also provided a small but clearly printed map, which shows the various railways, the boundaries of the different Military Commands, and the principal towns, the Headquarters of Commands and First-class Districts being underlined.

Major Moore is to be congratulated on his work, which should have a wide circulation.

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Questions and Answers for Cavalry Non-Commissioned Officers. By Colonel CROLE WYNDHAM. 8vo. 2nd Edition. (Presented.) (Kegan Paul, Trench, Trübner & Co., Ltd.) London, 1904.

Text Book of Small Arms, 1904. Official, 2s. 6d. 8vo. (Presented.) (Harrison & Sons.) London, 1904.

Wellington's Operations in the Peninsula, 1808-1814. By Captain LEWIS BUTLER. 8vo. 2 vols. 32s. (T. Fisher Unwin.) London, 1904.

Story of the Campaign in Eastern Virginia. By Lieut.-Colonel H. M. E. BRUNKER. 8vo. 2 vols. 7s. 6d. (Foster, Groom & Co., Ltd.) London, 1904.

War in Practice. By Major B. F. S. BADEN-POWELL. 8vo. 5s. (Ibister & Co., Ltd.) London, 1903.

Tactical Studies on the Battles around Plevna. By Captain T. VON TROTHA. Translated by First Lieutenant C. REICHMAN, U.S. Army. 8vo. 5s. (W. H. Allen & Co., Ltd.) London, 1896.

Notes for Officers Proceeding to India. By Major A. T. MOORE. R.E. 8vo. (Presented.) (R.E. Institute.) Chatham, 1904.

My Service in the Indian Army, and After. By General Sir J. LUTHER VAUGHAN, K.C.B. 8vo. 16s. (Presented.) (Archibald Constable & Co., Ltd.) London, 1904.

Instructions for Fitting and Wearing the Equipment, Bandolier, Pattern 1903. Official. Pamphlet (Presented.) (Harrison & Sons.) London, 1904.

The Sikhs. By General Sir J. H. GORDON. 8vo. 7s. 6. (Presented.) (William Blackwood & Sons.) London, 1904.

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